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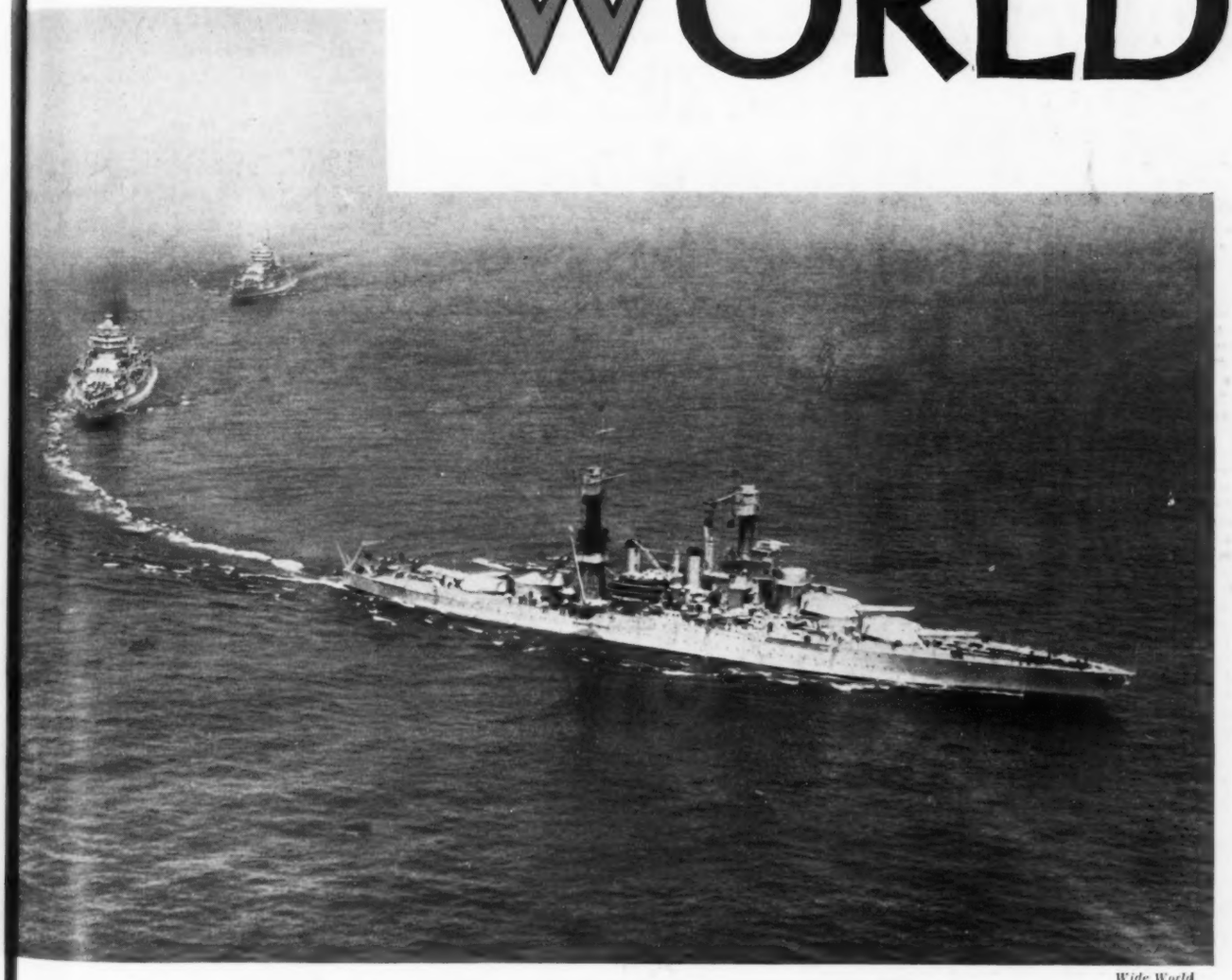
JUNE 16, 1934

ELECTRICAL WORLD



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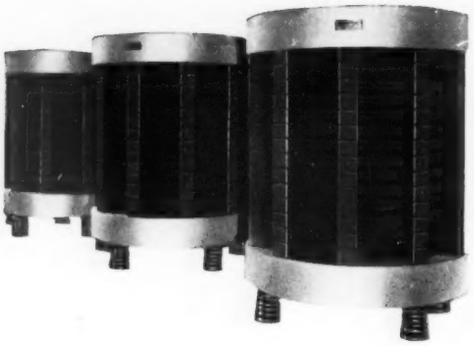

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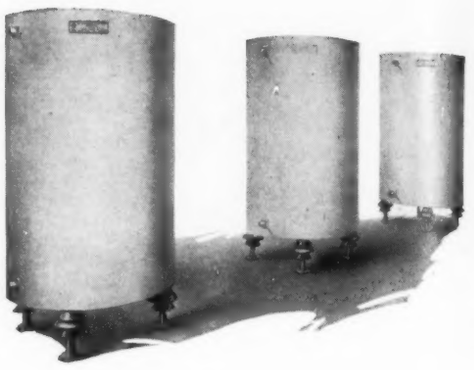

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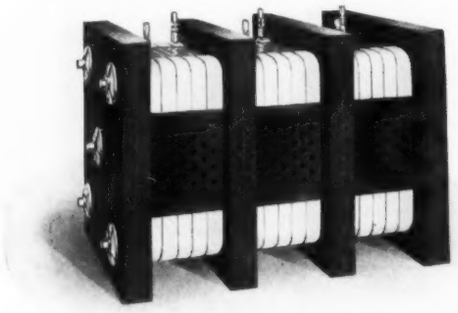

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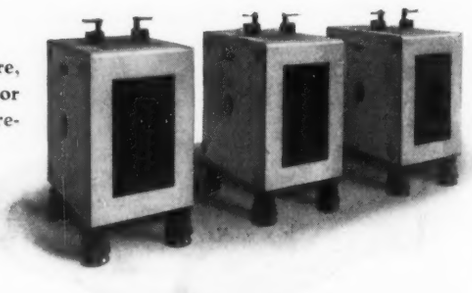

ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

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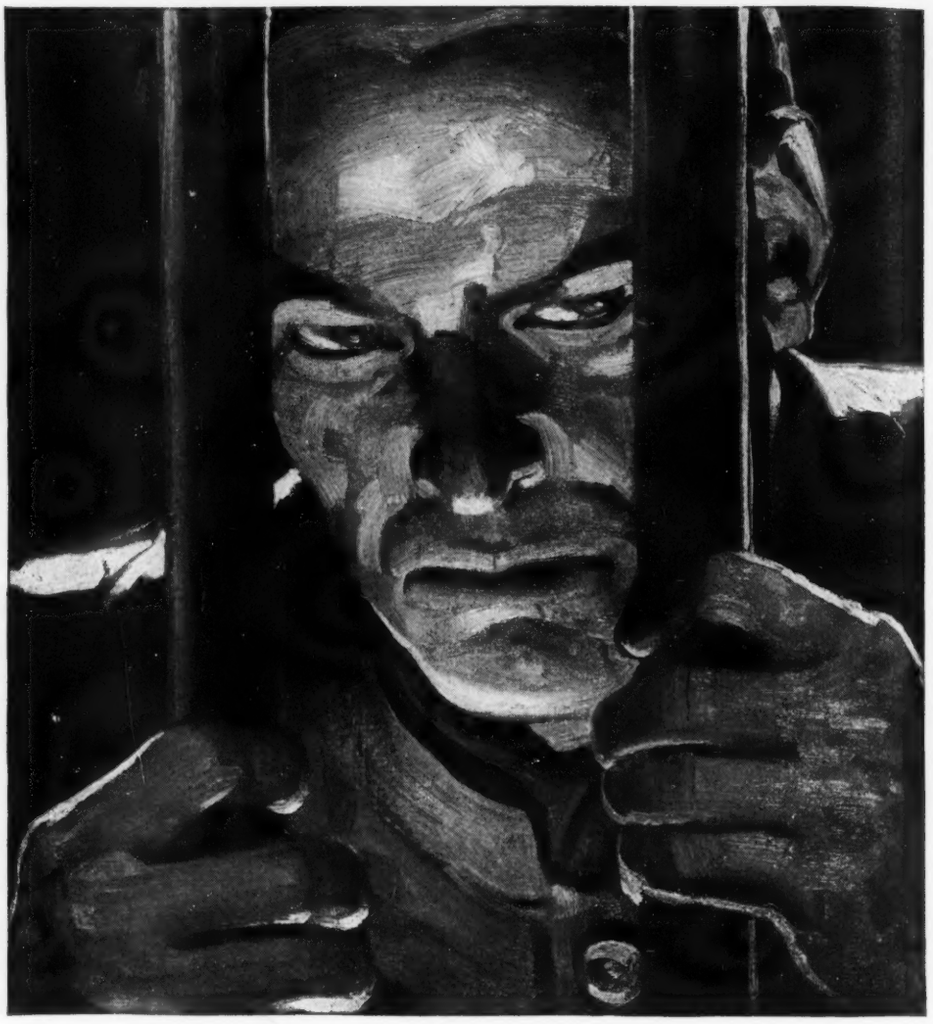

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ELECTRICAL WORLD

Established 1874—McGraw-Hill Publishing Company, Inc.

for the Week Ending

June 16, 1934

L. W. W. MORROW, *Editor*

Engineers in the New Commercial Era

Electric utilities must sell energy as they have never sold it before. That realization is taking hold everywhere—witness the vigor of the commercial addresses at Atlantic City last week. Fortunately, the power companies have for sale something that is now both good and cheap. The imperative success in selling it depends on keeping it high in quality and attractively low in price. That's where the engineer has always come in and where the reliance must be placed in the era ahead. The risk is that the pendulum of emphasis will swing so far to the selling side that technical progress will be restricted to a rest-on-the-oars coasting level of activity. Philip Sporn argued against that hazard modestly, admirably and convincingly at the E.E.I. convention.

There is no need to recite here all the things American Gas & Electric Company has done to profit by progressive and aggressive engineering. Interconnection has been worked overtime to avert heavy station outlays. Existing plants have been edged steadily to higher economies and efficiencies. Lightning has been all but licked. Who but the engineer could pave the way for relaying and protection that justifies the bold prophecy "reliability of a.c. transmission will within a comparatively short time be developed to the point where the use of two circuits to assure continuity of service will be almost unheard of"? Attaining that goal almost means a doubling of the usefulness of the major portion of prevailing transmission interconnection network, now so largely on a two-circuit basis.

In the offing is d.c. transmission through thyratron inverters with a chance to boost still higher the efficiency of existing and future ties. Meanwhile, economy measures in design have hardly more than got their stride as engineers proceed to forget the days of lavish budgets and hurried expansion. "A difference of only 15 per cent in the cost of a project counts for much in an industry where it takes five years or more to turn over the capital." If management will turn over the authority the engineers will show how to turn over the capital in still shorter time.

Distribution is another field where the opportunity exists to keep service good and make it cheaper. Rural extension costs have been cut on the A.G.&E. system. Diversion of energy has been thwarted, and with profit on the outlay. The complex and bottleneck service entrance is being replaced with something simpler. Bare common neutral is lowering distribution costs, and it may later be projected into the home. In the maintenance field early foresight led to the adoption of records that have meant much in planning field tests. Service continuity has gained by advance removal of equipment shown to be weakening.

IT IS not at all necessary to paint glamorous pictures of the wonders engineers may by research unfold some day in the future. A sustained emphasis on engineering is demanded merely to prosecute what has already been set in motion and bring this new wave into full fruition.

The industry likes to point with pride to the steady reduction in rates, independently of whether other prices shot up or slid down. Technical advances account for the bulk of that life-saving accomplishment. A rising price level demands ample and superior engineering brains to hold those gains and extend them. Consumers will buy more kilowatt-hours if they are good and cheap. The engineer and not the salesman determines how good and how cheap they can be.

Something Better Than Price Fixing

None of the codes of the electrical industry will be affected by the ban upon price fixing just announced by NRA. The manufacturers and contractors' codes embrace open price plans, but without provision for minimum price control. The power company and wholesalers' codes, now awaiting the President's signature, have no price features. Despite this fact, however, Washington's new price policy may serve to emphasize an opportunity.

Of late, too many industries have been suffering from a misconception that price control or price stabilization is the major, if not the only tangible benefit afforded by NRA. They have forgotten the interindustry competition for the consumer's dollar, in which too high a price on a commodity is often the most effective way to destroy its market, by encouraging substitutes. They are overlooking also the possible benefits offered by the codes through constructive co-operation in reducing costs.

So because the consumer has been abnormally price conscious for the past four years, that has become the dominant motive. Quality has been freely sacrificed for price. This has reacted upon the seller, until today industry is excessively concerned over price stabilization and neglects the very large possibilities for bringing down production, distribution and marketing costs, so that business can be done profitably within the competitive price level. Yet trade practice rules provided in many basic and supplementary codes of fair competition appear to open the door to great benefits in this direction.

It is safe to say of the several branches of the electrical business, as of other industries, that the greatest present menace to prosperity is not prices, but waste. The better training of salesmen, the more intelligent use of advertising and the elimination of uneconomic activities all increase the profits. Unnecessary losses from small orders, small customers, unprofitable territories and expensive warehouses and branch offices, as well as excessive trade-in allowances, terms of payment, quantity discounts and entertainment, all increase costs, which destroy profits no less than cut prices.

Here is something better than price fixing. No greater contribution to the recovery of the electrical business could be made at this juncture, therefore, than for the several national associations concerned to undertake intensive investigations of the wastes in distribution and marketing under present methods. For, once the facts are known, the codes will facilitate the correction of these evils, under trade practice rules.

What to Do in Load Building

Half of the national convention of the power industry last week was devoted to sales problems. There were eleven addresses on the program. Six were on commercial subjects. It is a far cry from the old days when there was one commercial session in five days of meetings. It is a symptom of the growing recognition that the most pressing needs and the most promising opportunities now lie in the field of sales

Above all else, interest centers today on the domestic market. Here two classes of customers stand out—prospects for refrigeration, ranges and water heaters and non-profit consumers who must be sold small appliances to end the present loss in serving them. How can this be done quickly? Three suggestions were made:

1. That greater financial support should be given to sales operations through very much larger expenditures for advertising and promotion.
2. That the power companies themselves should break the jam in selling to the home, caused by the high cost of financing installment accounts, by using their established low-cost collection machinery to reduce monthly payments to the smallest possible on dealer sales as well as their own.
3. That co-operation with appliance dealers should be given just as much consideration and support as the utility's own sales organization, since they represent more stores, sales personnel and potential load building influence.

On this whole problem of domestic sales all eyes are watching T.V.A. New rates, new appliances, new prices are under experiment. The new ideal embraced in their slogan—"Electricity for Everybody"—is getting wide publicity and stirring popular imagination. It is great advertising for the electrical idea, but how will it bear upon rates in other sections.

Meanwhile, two national co-operative sales activities will be under way through the coming season. A "running water" campaign will use the pump as entering wedge for home and farm service in rural territories. The Better Sight program continues, with the optical and paint people assisting. Air conditioning offers a new approach to all industrial and commercial customers where progress has been static for some time. The convention has shaped a rounded picture of profitable things to do that should fire the enthusiasm and stiffen the courage of every power company.

This Utility Bought a Private Plant —to Operate It

Instead of Scrapping the Isolated Plant a Way Was Found to Run It Profitably

By CHARLES BENHAM, JR.
Engineer Industrial Department, Rochester Gas & Electric Corporation, Rochester, N. Y.

ANNUAL load of 70,000,000 lb. of steam and about 1,500,000 kw.-hr. has been added by the Rochester Gas & Electric Corporation under circumstances, to say the least, unusual. There is an old saying that "If the mountain won't come to Mohammed, Mohammed must go to the mountain." So, if a prospective customer persistently refuses to become an actual one by ordinary means, extraordinary ones must be adopted.

For many years the Rochester Gas & Electric Corporation had been unable to secure the electric business of the Stecher Traung Lithograph Company. This company operated its own power plant under a joint agreement with two of its neighbors, whereby the cost was divided among them proportionately to the steam and power used and any profit or loss divided at the end of the year. During 1929 they secured the steam business of the East High School Annex, amounting to 1,500,000 lb. a year and both the steam and power load of the Cutler Manufacturing Company, amounting to about 5,000,000 lb. of steam and 60,000 kw.-hr. a year, the electric corporation losing the power business of the latter. They had also approached three other factories operating their own plants in the neighborhood for their steam and power business.

This industrial neighborhood is beyond the existing steam mains of the electric corporation and it would be uneconomical to enlarge and extend the mains, and so it was found impossible to secure the power business due to the need for steam. The representative of the utility company, who had labored hard trying to secure the power load, finding his logic and powers of persuasion coming to naught, in a moment of desperation said: "What is the matter with us buying or leasing your plant and selling you your own power and steam," and the answer was, "If you think you can do it there is nothing to stop your trying."

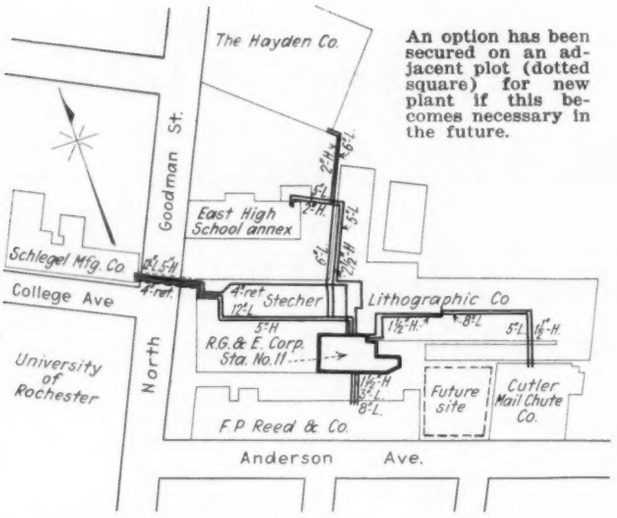
During the winter the heating steam requirements far exceeded the steam needed for power and in the summer the reverse was true, so that if the power lines of the electric corporation were interconnected with the Stecher plant coal could be saved in the summer and additional power pumped back into the electric company's lines in the winter. The steam load would be a very desirable acquisition to the utility, already one of the largest distributors of steam in the country, and in addition it was important to eliminate this plant as a competitor. The Stecher plant is well situated with regard to a number of prospective steam and power customers that might gradually be acquired. It is not so far from the existing steam district as to be beyond the probability that at some future date this district may be extended and interconnections made, with still further economies.

Fortunately, the electric corporation and its representative enjoyed the entire confidence of the Stecher company, so that the operating data and costs for several years past were made available, together with initial construction costs and subsequent capital charges. The management of the Stecher company was more easily persuaded as to the economy to it of the sale of its plant and the purchase of steam and power than the management of the utility of the benefits to be derived, so that the sales effort that had been directed upon the customer had to be reversed.

The arrangement that was finally made was that the power company purchased the boilers and generating equipment for the approximate amount shown on the books of the Stecher company and leased the space this equipment occupied for a period of fifteen years. Considerable legal effort was expended to be sure that all possibilities and probabilities were covered in the bill of sale, agreement of operation and lease. The financial standing and business health of the various companies were carefully investigated and proved to be most reassuring. In order not to be left in the lurch at the end of this fifteen-year period, an option was obtained for fifteen years on a vacant lot adjacent to the power plant and owned by the Stecher company, so that if conditions made it desirable or necessary a new plant could be built without entailing serious relocation of the steam mains.

The plant contains two 200-hp. Keeler boilers, one

Here was an industrial station that had been serving its neighbors with steam and electricity for years. Unable to secure the electric business and irked by the competition, this utility bought the facilities and continued the service profitably. So successful has been the move that other plants are now being considered for a similar approach. There may be many situations awaiting just such a power-sales policy.



Utility purchases boilers and generators of one industrial and serves four others and a high school annex

318 and one 338-hp. Heine boilers with type "E" stokers and superheater on the Keelers and an economizer on one Heine. The generating equipment furnishes 240 volts, d.c., and consists of a Nordberg uniflow driving a 660-kw. Crocker Wheeler generator, an Atlas Corliss engine driving a 300-kw. Crocker Wheeler generator and a Ridgeway driving a 100-kw. General Electric generator. The equipment also includes a 150-kw. motor-generator set that can be used both to produce alternating current from the plant or direct current from the electric corporation as required. With existing draft conditions 1,000 boiler-horsepower is about all that can be carried continuously. With draft conditions improved the 200-hp. boilers could carry 200 per cent of rating and the others 150 per cent of rating continuously, or a total of 1,784 boiler horsepower. Assuming that one 200 hp. is carried as a spare and the others run at maximum capacity, there would be 1,384 hp. available for continuous use.

On a day when the outside temperature fell to 2 deg. and with a stiff wind blowing the maximum boiler horsepower was 960, leaving 424 to spare. Assuming 20 per cent losses, there would be a margin of 1,150 lb. of steam per hour, so that there would still be capacity for additional customers that might be secured.

Mutually profitable even with slumped load

The estimates and basis of negotiations were made during the early part of 1929 and based on the three previous years' operation and the whole problem was viewed somewhat through the rose-colored spectacles of that boom period. It is a source of sincere gratification that this purchase has always shown a nice profit to both parties in spite of a severe drop in business, and this profit is not one merely of clever bookkeeping. The figures include a sinking fund completely writing off the equipment in fifteen years. The remarkable showing is largely due to the economies in operation effected by the electric corporation, for due to the depression, not only was additional load not acquired, but the existing load, particularly that of steam, was materially reduced. In 1928 the plant produced 125,700,000 lb. of steam, of which 71,500,000 lb. was sold. It generated 1,450,000 kw.-hr. and purchased 800,000 from the electric corporation. In 1933 the plant sold 53,700,000 lb. of steam and generated 1,175,000 kw.-hr.

In addition to the interest on the purchase price of the equipment, the Stecher company's expense for steam has dropped 4½ cents per 1,000 lb. from 1928, under private operation, to 1933. The corresponding saving in power has been 4 mills per kilowatt-hour, and this in spite of a considerable reduction in load, which would ordinarily increase unit costs. Besides these savings the company has been free of the responsibility of operating its power plant and is now free to devote its entire energies to its own business.

Sub-customers aided in economies

It was feared that the slight rise in rates to the other factories might cause some ill-feeling toward the electric corporation, and great care was used to advise these concerns in the economical use of power and steam. This was accomplished so well that the owners of these factories, instead of regretting the move, are most pleased that it was made. Their annual costs have remained about the same.

The purchase of this plant has enabled the electric corporation to step into a most desirable industrial neighborhood, with the majority of the customers already secured with a plant operating on a paying basis. All this in contradistinction to building a plant that has to wait several years for the load to build up to the point where it pays.

It is probable that the equipment will not outlive by many years the term of the lease. By that time it is expected that the load will have grown sufficiently to necessitate a new plant, or the downtown district will be extended to cover this area.

There is also in mind the possibility, remote perhaps, but nevertheless a possibility, that other plants at strategic points on the east side of the city might be acquired in the future and tied together in a network to supply most of that side of the city with steam.

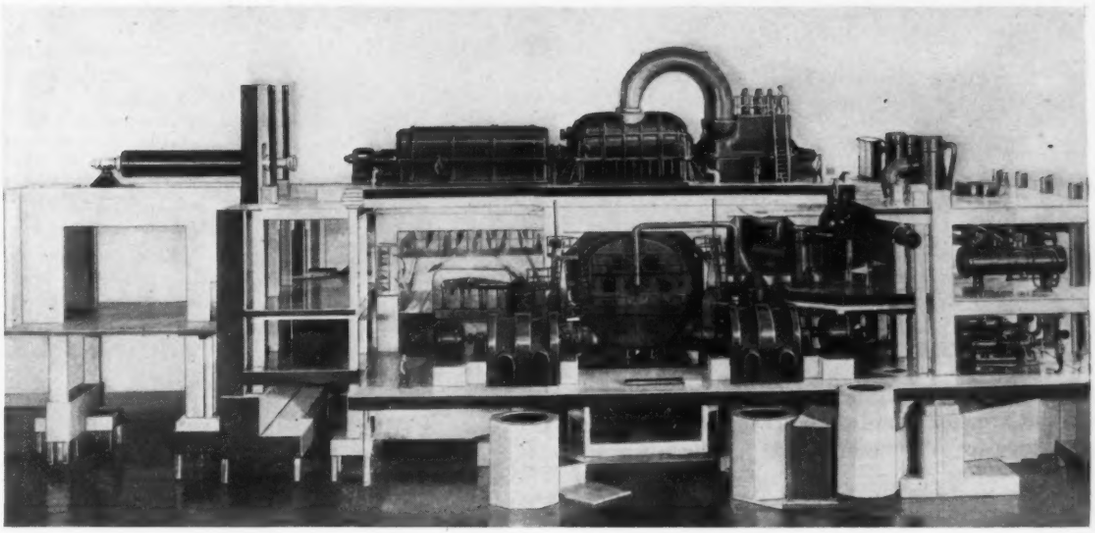
Now Mohammed and the mountain are side by side, to their mutual satisfaction.

Fuel Cost Cut $2,000,000

Every branch of the electrical industry is affected by further economies achieved in the generation of electrical energy. Every improvement broadens the field of possible application; every forward step tends to crowd out older equipment and to call for its replacement by something more efficient.

A recent report of the U. S. Geological Survey shows that the depression has not interrupted the steady improvement in utilizing fuel. In 1919 3.2 lb. of coal was required to generate a kilowatt-hour. That was the national average. The amount decreased year by year. In 1932 it was 1.50 lb. In 1933 it dropped to 1.47 lb. The change amounts to a saving of half an ounce per unit generated.

Put that way it seems insignificant. But it cut the fuel bill by fully $2,000,000, for in 1932 the total expenditure for coal, fuel oil and gas was $112,383,425 and the saving of 0.03 lb. per kilowatt-hour amounts to 2 per cent. The Census report for 1932 also gives the total operating expenses, again including municipal plants, as $803,100,258. The cost of fuel, therefore constitutes 14 per cent of the total operating expense.



Far superior to several isometrics and a multitude of projection drawings in adaptability to an evolving design was this demountable model built of celluloid, wood and soft metal tubing

Saving Money Through a Design Model

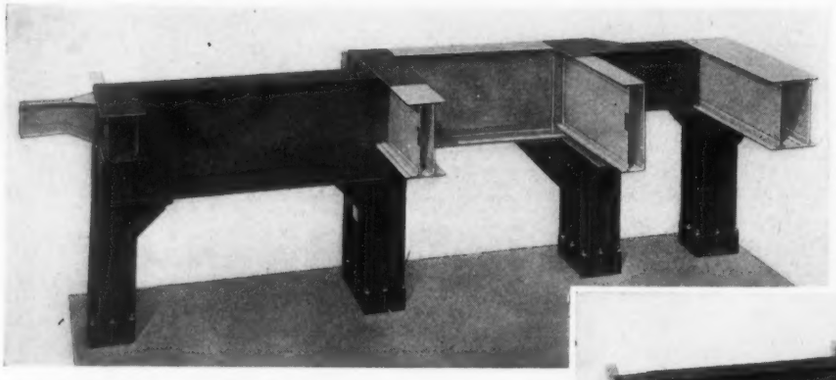
By W. J. RICHARD
Electrical Engineer United Engineers & Constructors, Inc., Philadelphia

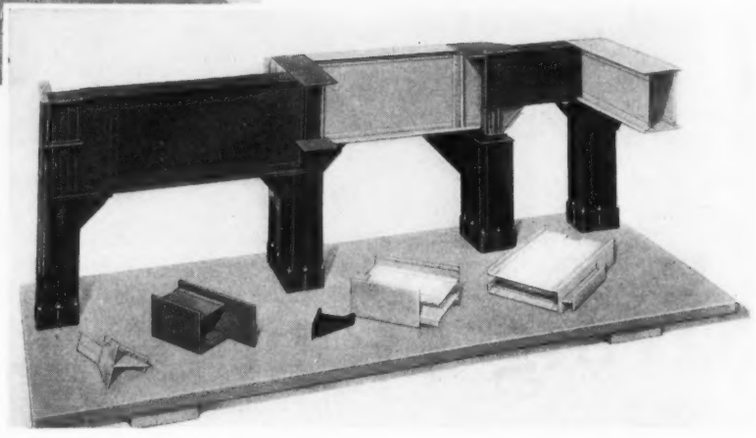
THE Richmond generating station as designed in 1924 provided for four 50,000-kw. generators, but only two of these were initially installed. They were, at that time, the largest single generating units in the world at 1,800 r.p.m. Since the advancement and refinements in the art of power plant equipment design have later made it possible to build machines of much higher rating and greater efficiency, the study of system requirements for present additional generating capacity, combined with the feasibility of installing larger equipment in the space reserved for another 50,000-kw. machine, resulted in the selection of a single 165,000-kw. unit. While the physical size of this equipment is not increased in direct proportion to the increased generating capacity, it is, nevertheless, much larger and heavier than the equipment for which the station was designed and constructed.

It was necessary, therefore, to not only make the utmost use of the available space, but to move and rearrange some of the present equipment and piping, make alterations and additions to the existing building structure and remove and rebuild foundations and water tunnels which interlaced and tied in with other foundations and water tunnels in such a manner as to make it most difficult to secure a clear concept of the problem. It has always been difficult to visualize the complexities of such a rebuilding problem, and even the best of the co-ordinated engineering frequently fails to develop some of the most important details or to avoid conflicts.

In order to develop and simplify all of the problems involved in a project of this nature, the aid of the picture, so to speak, in terms of three dimensions, such as isometric or perspective drawings or models, would be very useful. None of these, as ordinarily executed, are satisfactory. Isometric and perspective drawings are of very little help in design work as they can only be made after most of the details have been completed, and even then several views are required to show the complete installation. If such drawings could be made in advance, it would still be difficult and tedious to co-ordinate the relative positions of structures and equipment in one view with those in another. Thus, the only remaining instrument of possible value was the model, and if it was to be of any use it had to be built before or at the same time the general layout and detail design work was in progress. Most models built in the past have been executed by a special type of skilled workmen, requiring the preparation of extra drawings and the use of expen-

The design for the installation of the new 165,000-kw. turbo-generator in the Philadelphia Electric Company's Richmond generating station presented many unusual and intricate problems. A unique and valuable aid to the solution was devised in the form of a model, fabricated largely of celluloid, copper tubing and wood. The savings effected by its use will pay for their cost many times over. Out of it also came general refinements and improvements in the design and layout which developed from the ability to visualize the complete installation as a unit, before it was started and while it progressed.





Separate structural model made for steel work

(Above) It aided in assuring the desired transfer and distribution of stresses at joints. (Below) It was made so as to be easily dismounted for closer analysis of the efficacy of the design.

sive tools and equipment. They are works of art, but are costly and only useful in showing in miniature form something that has been accomplished. They are very interesting, educational and ornamental, but have no value in the solution of the problem except as a check on the final design.

The idea of constructing models, concurrent with the design, of inexpensive materials that could easily be fabricated and assembled in the drafting room by the designers was first conceived by the United Engineers & Constructors, Inc., for the Conowingo hydro-electric project, when models were built for the purpose of solving electrical problems connected with the design of the roof substation and transmission line. The material selected to fill the requirements was celluloid. It had the properties of being transparent, flexible and strong. It could easily be fabricated and quickly and securely fastened together with celluloid cement. If changes were necessary, it could be most readily taken down and reassembled.

In the design for the installation of the 165,000-kw. turbo-generator and auxiliaries at Richmond station it was obvious that with further developments in the original idea of celluloid models, they would be most useful in the solution of the problems involved. Consequently, a model was constructed in the drafting room by the designers as an integral part of the design. It was built to show principal equipment, piping and structures in the turbine hall relating to the new installation (Fig. 1). The existing building structures, foundations and water tunnels were first assembled, and as the design advanced the necessary structural alterations and additions and the installation of principal equipment and piping were included. It represented, in concise form, the information contained on many drawings and was of inestimable value in avoiding possible conflicts, interferences and misconceptions. It eliminated the necessity of making many preliminary layouts and of each designer having to study old detail drawings in order to visualize the existing limitations and conditions.

It was very useful in determining the best arrangement of equipment and piping, locations for structural columns and means of supporting new balconies, layout of the oil system, location of electrical conduits, minimum rearrangement of existing equipment, accessibility of equipment for maintenance and operation, safety features and methods of handling and assembling equipment.

The advantages or disadvantages of alternate design proposals were readily determined by incorporating the various schemes in the model where the true perspective relationship of all of the elements was immediately apparent. Undesirable schemes were discarded earlier and final decisions from officials and operators were obtained quickly without going into drawing details. This greatly expedited the project, for in most cases future plans were contingent on these decisions.

In regard to construction, it was valuable in making complicated detail drawings more comprehensive through the abiiity to visualize the complete assembly and offered valuable assistance in planning construction methods and sequence.

Where it was desirable, the celluloid was left in its natural transparent state to admit light or make it possible to see beyond a particular surface. Otherwise, it was painted various colors to represent concrete, steel or sections through structures. Toy men of the same scale as the model were useful in helping to visualize working clearances and the accessibility of equipment for maintenance and operation. For some parts of the model other materials were more adaptable than celluloid. Copper and lead tubing was used to represent piping and most of the auxiliary equipment was made of wood. Wooden models of the generator, high- and low-pressure turbines and condenser were furnished by the Westinghouse Electric & Manufacturing Company to assist in the co-ordination of that equipment supplied by it.

In designing the steel structure for supporting the turbo-generator the problem of interconnecting the steel in such a manner as to secure the desired transfer and distribution of stresses at the joints made it desirable to construct a separate model of this steel work, as shown in the illustration at the top of this page. The celluloid was worked into structural shapes and assembled, with interconnecting members painted with contrasting colors to show clearly the overlaps of the structural members. Each section could easily be dismantled for closer analysis, as illustrated above. The model was not only useful in facilitating the steel design but it was also a valuable aid to the fabricators in detailing and fabricating the steel and to the field in the erection.

Can Electric Drives Compete for Pipe Line Pumping Service?

A Discussion of One of the Toughest Problems of the Power Sales Engineers, With Suggestions for Its Solution

By W. H. STUEVE
Oklahoma Gas & Electric Company,
Oklahoma City, Okla.

WITHIN the last several years a growing tendency has evidenced itself to apply power to centrifugal pumps used in the pipe line and refining divisions of the oil industry by using internal combustion engines and gear speed increasers. In practically all the electric motor installations made so far on pipe lines constant-speed induction motors have been used. The centrifugal pump has operating characteristics which permit the mechanical efficiency to remain almost constant for speed reductions down to about 70 per cent of maximum. The pipe line characteristics follow these closely, in that the initial pressure required for decreased volume falls off as the square of volume. The horsepower, being a function of volume and pressure, will vary as the cube or third power of the speed or volume. To convert the flexible speed characteristics of the internal combustion engine into power input savings, when compared to the constant-speed induction motor, the curves shown in Fig. I were calculated.

With two pump units, each of which will deliver total volume at one-half total pressure, the operator of constant-speed electric pumps is forced to three methods of making his deliveries: First, with throttled headgate, as shown by the line "AX"; second, with headgate wide open at maximum rate of delivery for fewer hours per day, as shown by line "AY," and, third, at maximum rate for a given number of hours per day and finish out daily deliveries at minimum rate using one-half pump unit during the daily period, as shown by line "AD."

It is to be noted that the power requirements of the engine, curve "AE," are always lower than the constant-speed electric operation under most ideal theoretic operating conditions, spoken of above as the third operating choice. The most likely choice of operating methods would be the first, or to operate with throttled headgate for decreased capacities. The second choice is eliminated because the flow of oil through the line ordinarily cannot be stopped in cold weather, or operators do not care to shut down entirely. The third choice may be eliminated due to poor electric load factor.

Thus, if a power rate was offered to the pipe line company which would be competitive with engines at 100 per cent capacity or 100 per cent electric load factor, after all factors of fixed charges, labor, fuel and maintenance were taken into account, the power rate would have to be either a flat rate of the value at 100 per cent load factor back to 50 per cent load factor, or, in fact, a gradually decreasing rate, instead of the customary gradually increasing net rate, in order to be competitive with variable-speed engines. This is brought about due to the increased energy required to be purchased, using constant-speed motors, at volume deliveries of less than 100 per cent capacity, as against the actual energy an engine is called upon to produce for like volumes.

It is apparent, then, that with present accepted electrical equipment the pipe line is justified in asking for a flat power rate for all load factors from 100 per cent down to about 50 per cent; yet, on the other hand, the power utilities cannot offer such a rate, since they, being regulated by commissions, must sell their wares to all alike. Therefore, we now reach an impasse, and the logical solution of the difficulty may be for the electrical industry to look about for equipment that can meet the pipe line requirement in the way of speed control or its equivalent. Following are the several suggested methods of meeting this problem:

Method of securing speed variation

Scheme 1—Use of alternating-current variable-speed motor, obtaining speed control by varying rotor resistance, commonly known as slip-ring motor.

Scheme 2—Use of direct-current motor as prime mover providing conversion from alternating-current supply with rotary converter.

Scheme 3—Use of direct-current motor as prime mover providing conversion from alternating-current supply with mercury-arc rectifier.

Scheme 4—Use of variable-speed alternating-current motor—900 r.p.m.—with rocker brush and commutator for speed control, geared through one to four speed increasers to centrifugal pumps.

Here is a challenge to the electrical industry. For oil pipe line pumping the constant-speed squirrel-cage induction motor cannot compete with the oil engine in most cases because of lack of operating flexibility. The alternative electric drives are too costly. Mr. Stueve states the problem and out of a wide experience in selling energy for oil field supply suggests a reasonable approach to its solution.

A.S.M.E. Mid-Continent Petroleum Section, Tulsa, Okla. May 16, 1934.

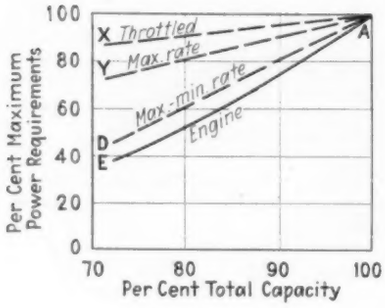


Fig. 1—Power requirements of motors and engines

Operation of two constant-speed electric units as against one engine. Line "AX" both electric units working continuously with headgate throttled. Line "AY," maximum delivery from electric pumps for definite period and shut down rest of time. Line "AD," maximum delivery for definite period and reduced operation rest of time. Line "AE," engine operating at variable speed.

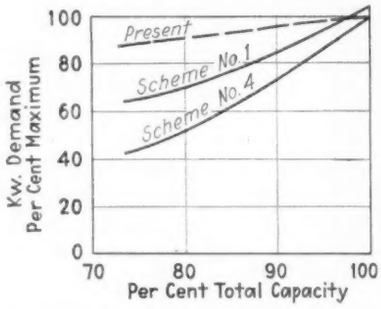


Fig. 2—Less energy used by variable speed motors

At the top is the energy requirement of the constant-speed motor. Next below is that of the slip-ring type and lowest comes the low-speed commutator type motor with geared speed increaser.

Scheme 5—Use of constant-speed alternating-current motors with isolated alternating-current generators driven with variable-speed engines, and speed variations being secured by frequency change.

Scheme 6—Use of a great number of constant-speed alternating-current induction motors, each driving pumps which would be fitted to head-capacity conditions, say for 95, 90, 85, 80, 75 per cent capacities.

It is generally recognized that if speed control of electric motors and consequent volume control could be obtained from 100 per cent down to about 75 per cent the problem would be solved as to making the electric station compete with variable-speed engines.

Any one of the above-mentioned six methods of securing speed variation would increase the first cost of an electric motor-driven pump station, yet the benefits derived in the way of decreased purchase of power might be overcome by the fixed charges on the increment of investment increase. Of course, the thing to be taken into account first would be the acceptance of any or all of the proposed schemes by the pipe line engineer. By making comparison of the six schemes with the now standard accepted method of making station installations and using such present station as a base, the accompanying table was prepared to show the relation between first cost and operating efficiencies. From the table it is noted that only Scheme 1 and Scheme 4 are within the scope of reasonable first cost and constant efficiencies.

Comparative Table for Electric Pump Station of 600-Hp. Installed Prime Movers

	Relative First Cost	Over-all Operating Efficiencies at Capacities of 100%	90%	80%	75%
Typical Present Station	1.0	70.5	69.4	67.2	65.5
Scheme 1	1.15	68.0	60.5	54.0	49.0
Scheme 2	1.48	63.0	61.8	59.7	57.0
Scheme 3	1.57	65.0	63.5	61.3	60.0
Scheme 4	1.30	70.5	70.5	70.5	70.0
Scheme 5	2.50	...	...	...	...
Scheme 6	1.8	70.5	70.5	70.5	70.5

The curves in Fig. 2, showing hourly energy required at various capacities, indicate the advantage of Scheme 4 over the others. It is true the investment is approximately 30 per cent greater than the present accepted practice of using alternating-current, constant-speed motors, but note that the energy savings are from 25 to 50 per cent and the increased investment would easily pay for itself in from one to two years' operation at a fair capacity factor.

This discussion thus indicates that the use of a brush-type alternating-current variable-speed motor of about 750 to 900 r.p.m. maximum, geared to a centrifugal pump through 1 to 4 or 5 speed increaser, would probably overcome the present objections to constant-speed motors and at the same time justify gradually increasing rates for poorer load factors.

The problem confronting the electrical industry then would be to gain approval of the pipe line designer for the commutating type motor. Fire walls can be installed between the motor and pump room at a reasonable cost to eliminate any fire hazard, which cost is included in the table under the caption "Relative First Cost." Large refineries are using this type of motor for hot oil charging pumps, where the hazard is no doubt greater than would obtain in a line pump station.

While the use of Scheme 4 appears probably the most economic, it must not be construed that Scheme 1, using "slip-ring" variable-speed motors, should be entirely eliminated from consideration. The lower relative cost of Scheme 1, coupled with a supposition that volume control from 100 to 85 per cent would be sufficient and satisfactory to pipe line operators, would tend to justify consideration of the slip-ring motor. The slip-ring motor can be made totally inclosed, and if a fire wall is installed fire hazard would be entirely eliminated.

Just How Reliable Are Soldered Connections?

By C. C. CORNELIUS
Kansas City Power & Light Company, Kansas City, Mo.

Soldered splices have been used for a long time with good results when properly made. Likewise, when properly made it is possible to obtain very good conductivity and the joint will have a long life. The cost of twisted and soldered splices is usually the basis for economic studies on the use of other mechanical splices. The limitations of soldered joints have been brought out by the use of higher strength conductors developed for long-span transmission and distribution lines. The solder twisted splice is not applicable to hard-drawn copper, Copperweld, A.C.S.R., High-Tenso and the high-strength alloy wires. Cold bending sets up internal stresses which become greater with the higher tempered wires. Medium- and hard-drawn copper are difficult to solder without annealing the wire at the joint and leaving a weak point in the wire.

Other objections to the use of soldered joints are: A good joint of this type must have a clean surface before the application of solder. This is sometimes difficult to obtain on outdoor work on account of dirt and dust in the air, smoke, etc., which affects the quality of work done. Some difficulty has been experienced in obtaining the proper proportion of lead and tin in the solder as obtained from the manufacturer. Too much lead in the solder lowers the melting point and the joint

Examination of Soldered Joints*

Test No.	Size of Wire	No. Neck Turns	No. End Turns	Soldering: End Turns	Soldering: Neck Turns	Length of Joint, In.	%Conductivity of Joint to Same Length of Wire
1	4	5½	3½	No	Completely	9½	134.1
2	4	..	3½*	...	Yes†	5¼	110.9
3	4	3	3½	No	Yes	6 3/16	120.8
4	4	4	3	No	Yes, one-third	9¾	125.6
5	4	4	2½	No	Yes, top and sides	7⅛	121
6	4	2½	5½-2½	No	Spottily		120.5
7	4	2	5-4½	On the 5	Yes, one-half	6⅞	130.7
8	4	1½	3½	Minimum	Minimum	3¾	124.7
9	6	3	4½	No	Cold solder	5¾	117.7
10		5½	2½	No	Middle 3	8½	126.4
11		4	5½-2	No	Top and side	9½	124.9
12		2	2	No	Scantily on top	4½	101.7
13		2	3½-3	No	Yes, top of	3¾	115.7
14		4½	3-2	—	2½ in.	9¼	130.8
15		3	2-2	No	Well	4⅜	123.0
16		2	2½	No	Well	5½	123.3
17		1½	2½-3	2½—Yes	Well	3½	117.2
18		2	2½	No	Well	4½	123.5

Tensile strength tests on a few samples soldered twisted splices gave the following results:

No. 8 S.D.—The wire broke on all three sample splices.

No. 6 S.D.—The splice broke first on one sample. On ten other samples the wire broke.

No. 4 S.D.—Six samples, of which half broke at the splice and the other half broke in the wire.

No. 2 M.H.D.—Six samples, all of which broke in the splice.

*These tests were made from a number of old soldered joints cut out of used wire as it passed through the salvage division and joints picked at random. All wire soft drawn.

†Flat space in middle of joint held together by pair of connectors and fairly cold solder poured over two-thirds of top of joint to thickness of 1/16 in. to ¼ in. and solder ran down over sides, forming icicles up to ¼ in.

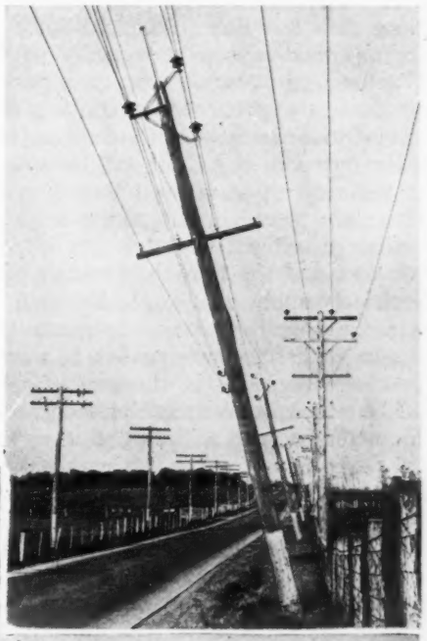
may not carry its expected load. Too much tin makes a hard solder which may not properly stick to the conductors and may be brittle and not have sufficient strength to stand vibration.

It should be remembered that solder has about nine times the resistance of copper and in any soldered joint the solder which must carry the current must have at least nine times the area of the cross-section of the copper conductor in order that the joint will have equal carrying capacity as the conductor. Numerous cases are on record of where this balance did not exist and under heavy loads or short circuit the solder has melted and spewed out of the joint. This is due largely to too short a solder pocket, especially in older type soldered lugs.

Important 33-Kv. Line Rebuilt While Still in Service

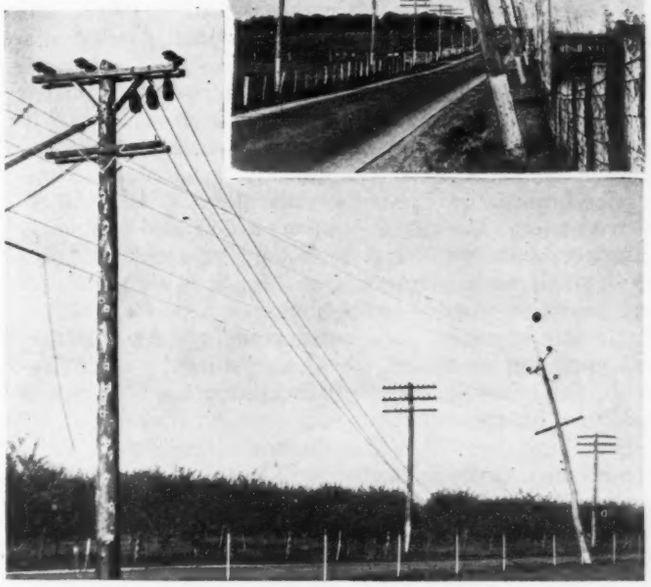
The line forces of the Potomac Edison Company had an interesting task in rebuilding a 33,000-volt wood-pole line from Martinsburg to Winchester. To reduce the chances of interruption, the line could be taken out of service only a few hours each Sunday. This specification gave little difficulty on parts of the line, but in one 10-mile section the new line had to be built within 2 or 3 ft. of the old line.

The job was done in sections of about 2 miles each. Old pole holes were enlarged and the old poles pulled toward the road to give clearance for the new line. In some cases, to give clearance, old poles were pulled and put on top of the ground. As clearance was thus provided, new poles with crossarms attached were erected and guys were installed. The No. 4/0 transmission wires were pulled out through sets of snatch blocks on the field side of each pole. The wire was placed on the field ends of the crossarms and pulled to the proper tension with temporary dead-ends at each end of the section. Then, on Sunday, with 52 men and five trucks, the old line was killed and the new line tied in. Temporary dead-ends were made in the old line at each end of the section, the old 33,000-volt conductors and bo-arrow arms removed, many of the old poles topped and the new line energized. Later the distribution and telephone lines were transferred and the old poles removed while another new section was under construction. This work was done along an important highway without a lost-time accident and without any damage to the property of others. Superintendent Jack Funk and his force accomplished a difficult task with skill and safety.



Rebuilding a 33,000-volt line in close quarters

Snatch blocks ready to install a new section of line



To Lower Range Wiring Costs—

Simplify the job, make as much of the installation as possible a part of the utility system, help to develop new equipment and work toward code revision

By E. A. HEATH
Kansas Gas & Electric Company, Wichita

EXISTING costs to the customer of rewiring his home to serve an electric range must be reduced. Experience indicates that they can be reduced by a co-ordinated attack along the following lines:

1. Simplify the wiring scheme by adapting existing materials to present code restrictions.
2. Design the wiring scheme in such a manner that a portion of the equipment may become and remain the electric supply company's property.
3. Design new equipment, if need be, or point out such requirements to manufacturers for development.
4. Bring about less restrictive code requirements.

A long time is required to attain noticeable results along this last line of attack, but a great deal can be accomplished reasonably quickly with the three others. The material presented here is a partial solution of this problem—the problem of reducing the cost of a range service to a magnitude of something between $15 to $20.

Referring to Fig. 1, it will be noted that use is made of the recently developed low-voltage circuit breakers. These are placed in a separate outdoor box located immediately below the meter. It is proposed that these breakers and the box shall remain the property of the electrical supply company. By such an arrangement it is not necessary for the customer to purchase a new service switch, which makes a material reduction in his cost of wiring for the range.

The circuit breakers are placed in a box separate from the meter because it is desirable to have a scheme that will make use of whatever standard outdoor meter box assembly the electrical utility industry shall develop and adopt in the future. Also, there is no small, compact outdoor box on the market that will contain both meter and breakers. Finally, it is not at all improbable that it may be desirable to place many of the outdoor meters on poles. This design will permit the installation of the service breakers at the house regardless of the location of the meter. The circuit breakers are housed in a small aluminum box which can be bought at a cost, locally, of about $1 each. Referring to Fig. 3, it will be noted that provision is made to accommodate a two-pole and a single-pole breaker. Two outlet couplings are available and operation of the switches is afforded by means of small, flat, push-pull levers that indicate open or closed condition of the switches.

In a few cases like that illustrated by Fig. 2, only one 50-amp., two-pole breaker will be necessary. In this instance the existing service switch is conveniently picked up as a branch off the circuit running directly from the service breakers to the range. This arrangement will

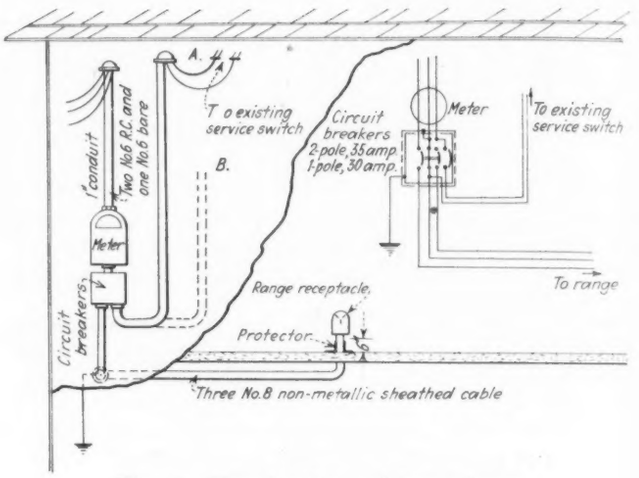


Fig. 1—Two-breaker wiring scheme

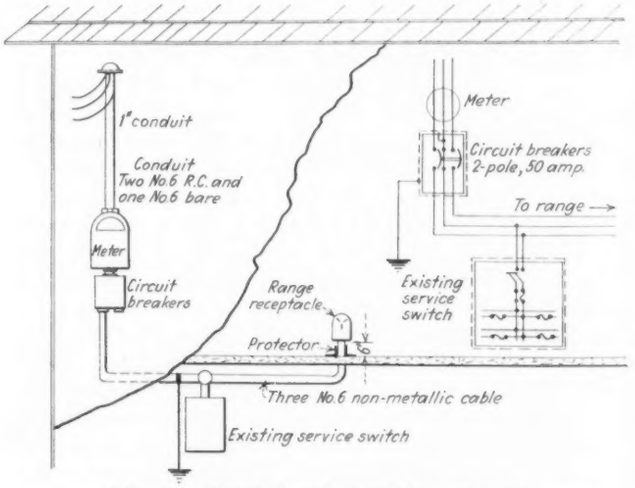


Fig. 2—Single-breaker wiring scheme

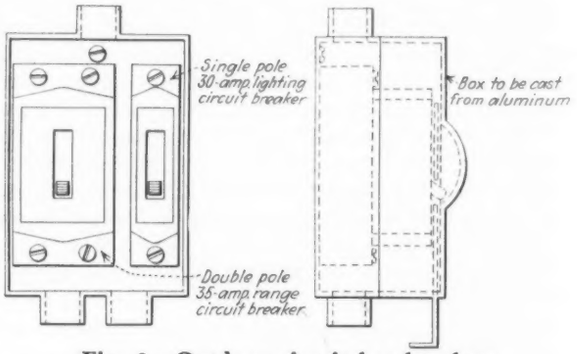


Fig. 3—Outdoor circuit breaker box

Breakers can be operated without opening box by means of slotted plates extending through bottom of box.

violate some local electrical codes, but it does not violate any of the provisions of the 1933 National Electrical Code, if the branch wires to the existing service switch are the same sizes as service entrance wires.

In other cases it will be necessary or more convenient to run separate circuits to the range and existing service switch. There must be used, then, a 35- or 50-amp., two-pole breaker and a 25- or 35-amp., single-pole breaker, depending upon the size of the existing service entrance. This condition is illustrated in Fig. 1. If the existing service entrance is not in conduit and an open connection must be made as at (A), Fig. 1, it seems advisable to utilize some type of concentric conductor cable for the service drop in order to prevent the customer from indulging in "current diversion" by installing jumpers between the two outlets.

Range receptacles cost too much

The use of a range receptacle is indicated. At the present time this is not the cheapest method of making the range connection, because three-wire receptacles, plugs and cords are expensive pieces of equipment—too expensive. Provision should be made, however, to connect or disconnect a range without calling in an electrician. It is an absurd situation that an electrician must be called in to connect an electric range even when the house is wired for it. In this writer's opinion, all ranges should be equipped by the manufacturer with a standard cord and plug and all range circuits should terminate in a standard receptacle. If this practice were universally carried out it is evident that the electric range might soon become as flexible and convenient to use as the electric refrigerator.

At the risk of being considered radical, this writer suggests that it is not illogical for the electric supply company to install and own the range circuit up to and including the receptacle. A sufficient precedent can be found in the fact that the telephone companies install and remove their circuits and equipment at will.

To return to the discussion of this wiring scheme. The service entrance is indicated as No. 6 wire. Now, most six-room houses with a 7.5-kw. range will have a "demand" of 8 kw., according to the National Electrical Code way of figuring. This is 35 amp. at 230 volts, for which No. 8 wire is adequate. Admittedly, if No. 8 wire is used one can make another small reduction in costs. Whether to use No. 6 or No. 8 must be decided for each particular customer. In general, it is desirable to use No. 6, but where costs must be cut to a minimum and it seems that there is little likelihood of much additional load, then No. 8 wire can be used.

While non-metallic sheathed cable is indicated for the range circuit, it must be admitted that this material will not reduce costs unless labor costs are rather high. Another objection lies in the fact that many local electrical codes will not allow its use in basements or for major appliance circuits, although it is perfectly adequate and allowed by the National Electrical Code. Electrical metallic tubing can be used where rigid conduit is required at a cost comparable to that of non-metallic sheathed cable if labor costs are reasonable. So one could go on, indefinitely, pointing out variations and modifications. The scheme described in the foregoing is not intended to cover every condition that may be encountered, but it is flexible enough to have a rather wide application.

Informal opinions on present conditions and problems confronting the industry are helpful. We welcome to this forum the type of discussion presented by Mr. Lester and hope others will discuss industry questions here in a similar constructive vein.

Bernard Lester says . . .

Assistant Sales Manager
Industrial Department,
Westinghouse Electric & Mfg. Co.

Profits for the customer should be the approach to today's markets

The "good old days" found the "good old salesman" operating according to the "good old rule"—"know your customer, know yourself and know your product." He knew how his apparatus was made, what it was made of, what it was made for, and the details of price, terms and delivery. He could recommend this apparatus for a given service. His psychology was an apparatus psychology—*his* apparatus, and he voiced it at every opportunity. Surely apparatus was needed by the purchaser, and he went headlong into a demonstration of why his apparatus was best for the purchaser.

In approaching the changed method of selling, let me not create the impression that the salesman need not know his product. He most certainly must know it, but his viewpoint must be broader and his projection further. His customer in the large majority of instances has no ultimate interest whatever in the apparatus he is selling. What interests the customer is *what the use of the apparatus* will do in helping the customer *make a larger over-all profit* in his operations. And this gives us the simple principle upon which the changing method of selling is based. It may be briefly stated as the use of engineering and sales talents skilled along the lines of promoting an economic analysis of the problems peculiar to the customer's production processes, and a demonstration to the management held responsible for profits, of the justification of expenditures for a revised or new production layout. We fully recognize that this idea and practice is not new, and has been pursued by some suppliers for years, but it has not been by any means general, nor has it been the point of view of the average engineering salesman in this field.

With this changing point of view we have a different concept of the volume and character of the market. The old rules based upon normal growth in the use of a line of apparatus, and a totaling of the sales of all competing companies, may mean little. The large growth in commodity selling has come through the development of new products and the development of new uses for old products, aided, of course, by advertising. But how has this been done? By a most thorough study of the mind,

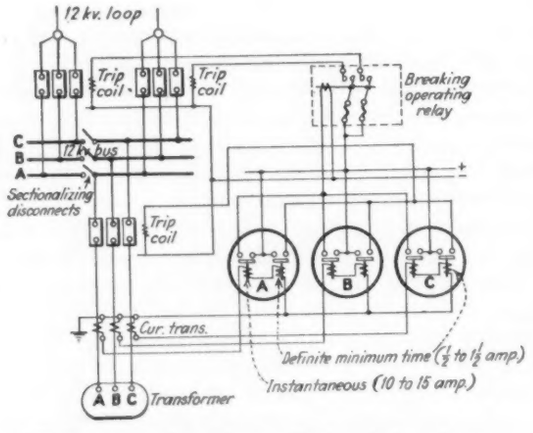
habits and pocketbook of the commodity purchaser. The builders and distributors of machinery and equipment have lagged behind in this thinking, and have focussed their attention too much upon details of apparatus sold. Builders and distributors of machine tools are recognizing this. With the demand past for machinery capable of providing increased production, they are now focussing their attention in design and distribution upon machines that are more flexible in productive capacity, and can produce economically a greater variety in output of product. The changed method of selling today has for its vitalizing force "profits to the purchaser."

Simple Relay Scheme Avoids Higher Breaker Investment

By RICHARD BANZ
Chicago, Ill.

Considerable savings in installation costs have been effected by the Commonwealth Edison Company, Chicago, in its industrial substations through the adoption of a new scheme of relay protection. Primary supply is by a 12-kv. loop system with lines in and out of each substation and with the substation 12-kv. bus an integral part of the loop. Connection of customer's equipment to the bus is through one or more oil circuit breakers which heretofore have been standard as equal to the supply loop breakers in short-circuit capacity. The new arrangement allows the bus tap-off breakers to be only of sufficient capacity to handle overload current, while the responsibility of short-circuit protection is entirely on the bus supply breakers.

This operation is accomplished by using a double relay arrangement connected to current transformers on the load side of the tap-off beaker as is shown in the accompanying diagram. One relay is of the time-delay type set at a current value in relation to the possible overload condition. The other is instantaneous and set at a much higher current value. Operation of the first relay, by an overload persisting for sufficient time, opens only the bus tap-off breaker and leaves the supply breakers undisturbed. But a fault of short-ciruit magnitude causes the instantaneous relay to close before the time-delay instrument has operated and thus opens the heavier supply breakers only.



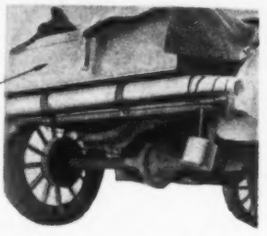
Relays cost less than oil circuit breakers

POWER COMPANY

How to Store and Handle Linemen's Protectors

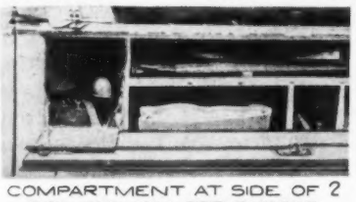
COMPARTMENT ABOVE DRIVER'S SEAT OF 2 TON TRUCK FOR PROTECTIVE EQUIPMENT ONLY

ONE PAIR OF RUBBER GLOVES AND A CARRIER ARE REQUIRED ON EACH UTILITY CAR



USE RUBBER GLOVE CARRIER, STOCK NO 911930 FOR GLOVES NOT IN ACTUAL USE

A RUBBER BLANKET SHOULD BE ROLLED AND STORED IN A CYLINDRICAL CAN AT THE REAR OF EACH UTILITY CAR



AT LEAST 3 PAIRS OF RUBBER GLOVES ARE REQUIRED ON EACH 2 TON TRUCK AND 2 PAIRS ON EACH ¾ TON TRUCK

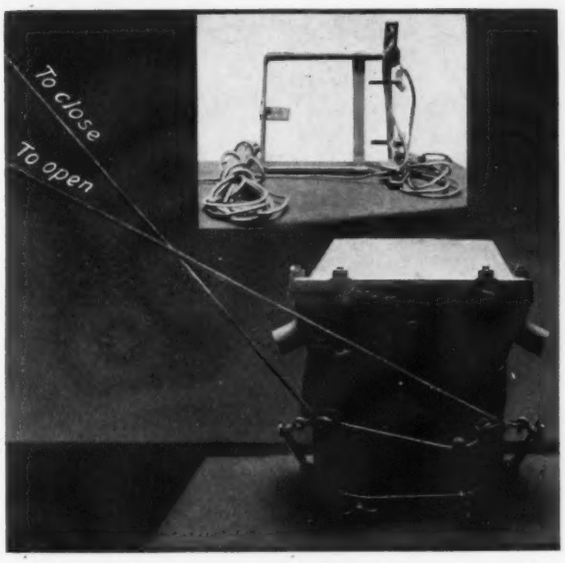
COMPARTMENT AT SIDE OF 2 TON TRUCK FOR RUBBER GLOVES AND GLOVE CARRIERS

All protective equipment carried on utility trucks should be so arranged that it is ready for virtually instantaneous use. Standard methods employed by the West Penn Power Company, as illustrated, call for storing equipment while it is dry and clean; keeping it free from contact with tools and hardware. The foreman is held responsible for its being kept in good condition. In addition to the working safety equipment shown, the trucks contain the necessary emergency safety kits and fire-extinguishing devices.

Making Manholes Safer by "Remote" Breaker Control

To safeguard underground workers against possible explosions in manholes resulting from circuit breaker operation in gaseous atmospheres, the Malden (Mass.) Electric Company uses a special frame and pulley outfit which can be applied to the breaker with ease and used from the street level to open and close the operating lever of the oil switch while the workmen remain outside the vault. The apparatus was designed by A. O. Summer-

ENGINEERING PRACTICE



Manhole breaker in closed position resting in pulley cradle

In inset frame and pulleys before attachment to manhole breaker

ville, electrical engineer of the company, in conjunction with the underground department, and it consists of a 1¼x¼-in. strap-iron frame equipped with wing-nut clamps and welded end lugs to which pulleys are fastened to carry ¼-in. window cord used in operation. Ordinary awning type pulleys are used.

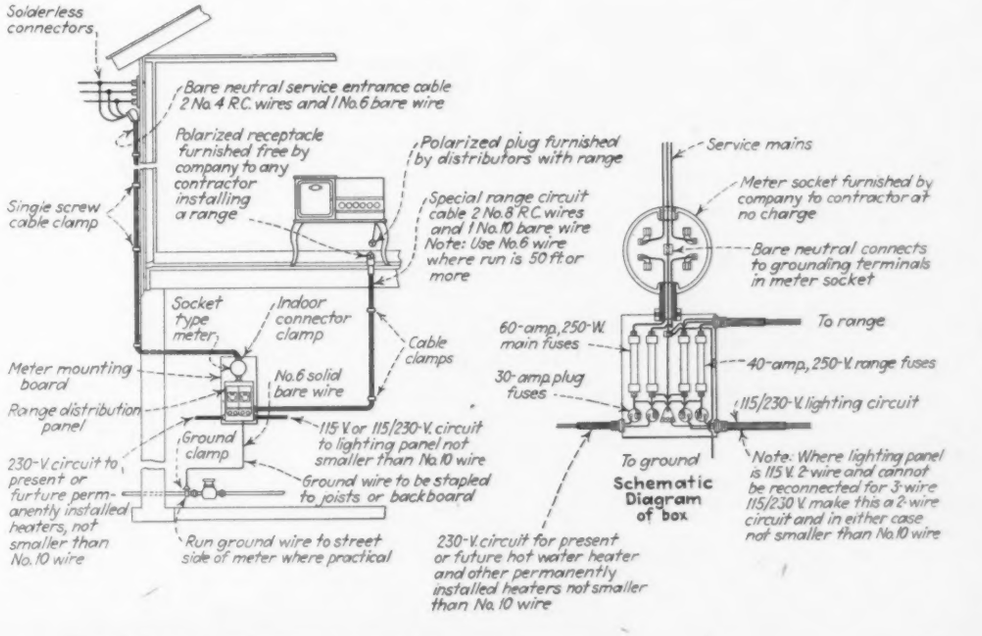
In handling the device, it is taken from a line truck and placed under the breaker as indicated in the accompanying illustration. The clamps are tightened and the two ropes carried out to the street. The breaker is then opened from the street by pulling on one of the ropes, the manhole being free from workmen. When the job has been finished the breaker is closed by rope pull, so that it is unnecessary to open or close a breaker with any one in the manhole. The equipment was developed as a result of an accident in which an explosion occurred when a breaker was opened with an underground man below the street level, through a spark which ignited an inflammable mixture of gases which had accumulated in the manhole over a considerable period.

Sleeve Simplifies Run of Secondary Service

A combination of secondary rack and a sleeve make an unusually simple job of running secondary service from a 6.6-kv. line. Southern Public Utilities Company uses the construction as shown in the illustration. The strain insulators are attached to the pole by eye-bolts, which take the strain of the service run. The spacing on the 6.6-kv. primary is for 11 kv. to provide for future growth.

To Better Range Wiring

Several electric light and power companies are using bare neutral service cables for ranges. The accompanying illustration is typical of most recent installation practices. In other instances modifications of this drawing are used. For example, omission of the polarized plug at the range, the use of BX cable instead of bare neutral cable from the range to the box and the use of two ground wires instead of one, one for the service and one for the equipment. These installations reduce costs greatly.


Solderless connectors
Bare neutral service entrance cable 2 No. 4 R.C. wires and 1 No. 6 bare wire
Polarized receptacle furnished free by company to any contractor installing a range
Polarized plug furnished by distributors with range
Special range circuit cable 2 No. 8 R.C. wires and 1 No. 10 bare wire Note: Use No. 6 wire where run is 50 ft or more
Single screw cable clamp
Service mains
Meter socket furnished by company to contractor at no charge
Bare neutral connects to grounding terminals in meter socket
Socket type meter
Indoor connector clamp
Cable clamps
To range
60-amp, 250-V. main fuses
40-amp, 250-V. range fuses
Meter mounting board
No. 6 solid bare wire
30-amp. plug fuses
115/230-V. lighting circuit
Range distribution panel
Ground clamp
115 V. or 115/230-V. circuit to lighting panel not smaller than No. 10 wire
To ground
Note: Where lighting panel is 115 V. 2-wire and cannot be reconnected for 3-wire 115/230 V. make this a 2-wire circuit and in either case not smaller than No. 10 wire
230-V. circuit to present or future permanently installed heaters, not smaller than No. 10 wire
Ground wire to be stapled to joists or backboard
Schematic Diagram of box
Run ground wire to street side of meter where practical
230-V. circuit for present or future hot water heater and other permanently installed heaters not smaller than No. 10 wire

Appliance Safety in Adequately Cured Cement

Description of a Study of the Effect of Vitrification on the Insulation and Safety of Household Appliances

By R. L. MELTON, K. W. BROWNELL
Research Laboratory, the Carborundum Company.

IN HOUSEHOLD electrical appliances several methods of insulating the heating element from the frame are possible, such as suspension of the former in air by suitable means; the use of asbestos, sheet mica and other substances possessing dielectric properties, or the use of embedding cements composed of ceramic bonded refractory granules.

The first method is unsatisfactory due to mechanical instability and lack of protection of the heating element. Furthermore, proper solid insulation has a higher dielectric strength, particularly at the operating temperature of the heating element.

Probably the greatest objection to asbestos is its hygroscopic nature, permitting a perceptible current leakage as the moisture content increases during periods of disuse. Asbestos is used only in the cheapest appliances or those in which flexibility is essential. From the standpoint of electrical resistance, true sheet mica is quite satisfactory, but in the proper condition for use it is expensive in first cost, expensive to install and has relatively poor thermal-conducting properties. Caution must be applied in the use of built-up or synthetic sheet mica, which is not so dependable for high temperature work due to the binders used in its fabrication.

Generally speaking, provided the proper electrical resistance under all conditions is secured, the use of embedding cements gives the most satisfactory results. They provide better protection of the element (from oxidation by the air, etc.) than any other means and are relatively inexpensive. Further, the use of embedding cements lends itself to mass production. The cement is easy to apply and its application requires no particular skill.

Difficulties largely due to moisture

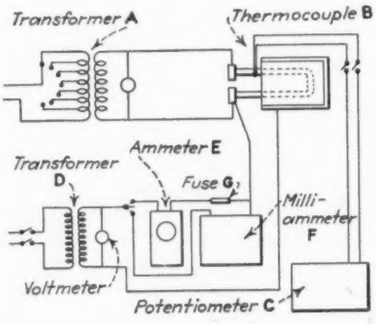
Electrical Testing Laboratories of New York City, acting for the appliance committee of the Association of Edison Illuminating Companies, found that many appliances actually marketed, and regardless of the particular type of insulation used, possessed under certain circumstances the ability to give the user a very disagreeable and at times even dangerous electrical shock, even though at other times the same appliance was entirely free from this objectionable characteristic. The E.T.L. ascertained that the difficulty was principally due to lowering of the resistance of the material used to insulate the resistor, as a result of absorption of moisture thereby.

It was found by the E.T.L. that the smallest current* which could be felt by the most sensitive person among 70 of their employees tested was 0.2 milliampere, and that a current of 7 milliamperes is sufficient to inhibit voluntary muscular action. These figures mean that with a 120-volt circuit the corresponding resistance would be 600,000 and 17,000 ohms respectively.

The criterion was accordingly set up by it that the resistance between the resistor and the sheath of an electrical appliance must be at least 600,000 ohms at all times. For purposes of determining the moisture effects it was specified that the resistance should be determined after the appliance had been exposed to an atmosphere with more than 85 per cent relative humidity and at a temperature of 85 ± 5 deg. F. for sixteen hours, the test being made with 60-cycle, 120-volt current while the appliance is still under these conditions.

Investigation showed that between appliances insulated with the same embedding cement there were tremendous differences in ability to withstand this test, and it was in order to investigate the reason for these differences and to outline a suitable method of utilization of cements that the present research was undertaken. For it, the four embedding cements which are believed to be most widely used in the trade were selected. These are pre-

*See Gordon Thompson, "Shock Threshold Fixes Appliance Insulation Resistance," ELECTRICAL WORLD, *June 17, 1933.*



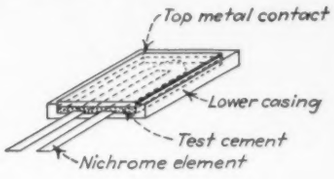
Leakage currents measured at 440 volts (25 cycles) between resistor and cast-iron sheath. Nichrome element heated by low-voltage current from transformer A. Thermocouple B close to iron casing, but removed from it somewhat to prevent short-circuiting any of cement resistance. Couple covered by same thickness of cement as nichrome unit.

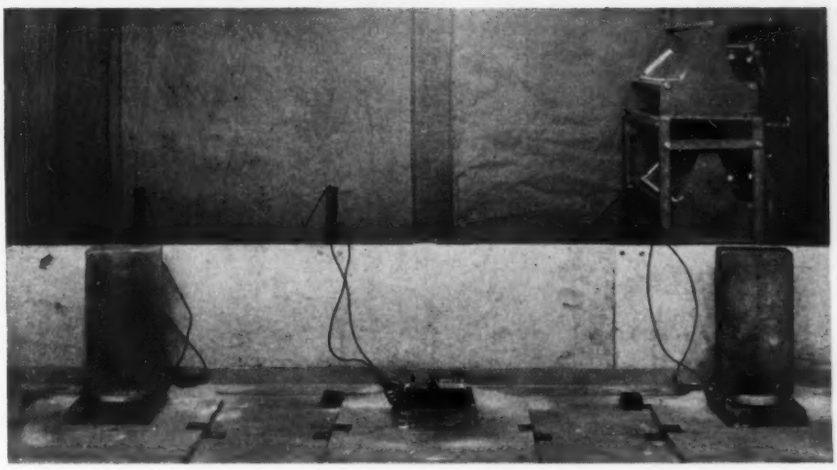
Fig. 1—Rectified microammeter used to read insulation leakage

Abstract of paper presented at recent joint convention of the Electrochemical Society and American Ceramic Society at Asheville, N. C.

Fig. 2—Flatiron simulated by cast-iron tray and cover

Flat U-shaped nichrome ribbons of about 35 gage metal, one inch wide, served as heaters. These have more surface than the usual coiled wire, but they facilitated better control and measure of cement thickness. Instruments are behind the partition.





and G. J. EASTER
Niagara Falls, N. Y.

pared by various manufacturers and are composed of a variety of ingredients and recommended for application in different ways by their respective producers.

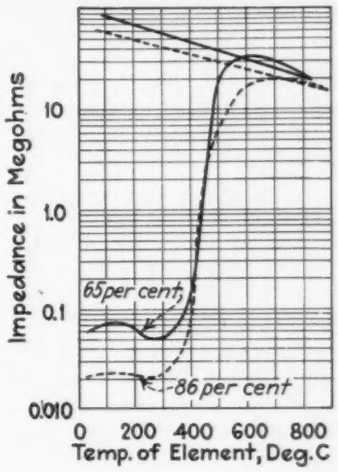
Method of measurement important

It has been the distressing experience of every one who has tried to do work of this sort that the value of the resistance depends as much upon the method of measurement as upon the variables which are being studied. This is perhaps only natural when the number of possible variables is kept in mind. With any given material it is obvious that the following factors all play a more or less conspicuous part, depending upon the method and conditions of measurements—humidity, temperature, polarization, voltage, frequency, contact resistance, true electrical resistance, capacity reactance, etc. After some consideration it was decided to use the alternating-current microammeter method described below.

The measuring equipment is shown in Fig. 1. To simulate an electrical appliance, such as a flatiron, in which the assembly would be simple and the cost low, a number of cast-iron pieces, such as shown in Fig. 2, were prepared.

The cement to be tested was placed in the "iron" base by various methods used in general practice, such as pressing, troweling while in a plastic condition, or insertion as a dry powder. The method of insertion in the base was found to make no great difference in the final results, so that no further consideration of the factor is needed here. In the units which were pressed a layer of moist cement adjusted to give the desired thickness was subjected to a pressure of approximately 2,000 lb. per square inch. After the cement was in place its surface was roughened to give a better contact with the layer to be applied later, whereupon the U-shaped resistor was laid on it and a second layer of cement applied on top and pressed in the same manner as the lower half. Similar methods of assembly were used with the troweled and dry cement, care being taken in every case to secure an accurate thickness of $\frac{1}{8}$ in. of cement between the resistor and the casing. The specimen was dried at 110 deg. C. (to bring it to the "green" state) or fired, as the case might be, and placed in a humidity chamber preparatory to measuring the electrical resistance of the insulation.

Fig. 3—Higher humidity increases cement conductance materially at low temperatures



In order to provide contact which would be at least as close as in ordinary service, a 15-lb. weight was placed on the iron top piece during the test to insure close contact. In Fig. 2 three units are shown ready for test. On two of these the iron weight is in position, while in the center one it is omitted so that the arrangement may be more readily seen.

In conducting the test the temperature of the heating element is gradually increased at a rate of about 10 deg. C. per minute to a temperature of 800 deg. C., or until the cement resistance begins to drop rapidly, by increasing the voltage applied to the element by means of a variable voltage transformer. It is thereafter slowly cooled at about the same rate. The leakage current from the heating element to the base plate and the temperature of the heating element are measured at five-minute intervals. Readings are taken both during the heating and cooling of the heating element, thus accounting for the distinct difference between the two branches of the curves shown in Fig. 4.

The lower or heating branch of each curve depicts the change of resistance as the moisture is driven out of the cement. As the moisture is driven off the resistance

With the increasing sale of low-priced domestic appliances, the study of insulation is growing in importance. Recent experiments now show that shock can result from the absorption of moisture by the insulation. Ceramic cements tested superior to other insulating materials, but even here safety depends on their being thoroughly vitrified. New experience from a new source.

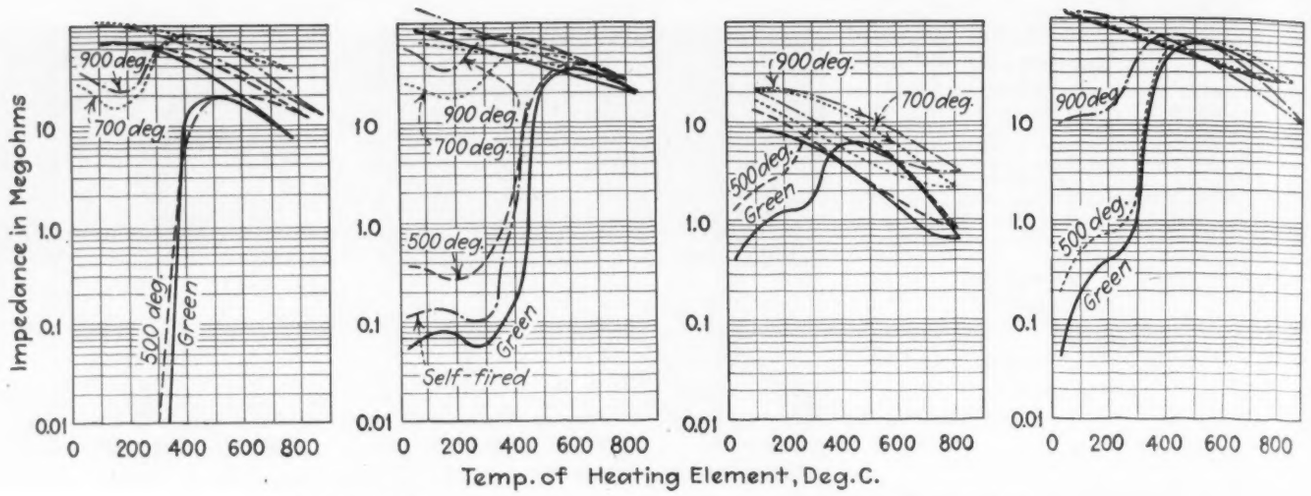


Fig. 4—Effect of firing on four common cements—A, B, C and D

Upper sloping branches of curves show true value of impedance of dry cement layer.

becomes much higher, so that the true value for the layer of dry cement corresponds with the upper or cooling branch of the curve.

Humidity control aided by chemical indicators

Due to the ready availability in the laboratory of a humidity room operating at 65 per cent humidity, these tests were, except where otherwise noted, carried out at 65 per cent humidity rather than at over 85 per cent, as specified by the E.T.L., and also that due to the fact no 60-cycle current was available all measurements were made at 25 cycles. Both these variations cause the cement to appear better than they would if tested under the conditions specified by E.T.L., inasmuch as the capacity leakage increases with frequency and the conduction due to presence of moisture is also somewhat greater after subjection to 85 per cent humidity than at 65 per cent. The approximate magnitude of the difference is shown in Fig. 3, where corresponding curves are given for the same cement under the two humidity conditions.

In the later portion of the work humidities have been held at 86 per cent ± 1 per cent, using a humidity cabinet in which air is circulated at a constant temperature over a saturated solution of $KHSO_4$. The salt solution is contained in a lead pan occupying the bottom of the cabinet and air circulation insured by means of a small fan. The only precaution necessary to maintain the apparatus in good working condition is to add a small quantity of water occasionally and to keep a coating of paraffin painted around the inside of the upper edge of the pan to keep the salt solution from creeping up the side of the container. Relative humidities over a considerable range of values may be readily obtained in this way by varying the salt, a saturated solution of which is

Fig. 5—Some increase in resistance with thicker cement layer

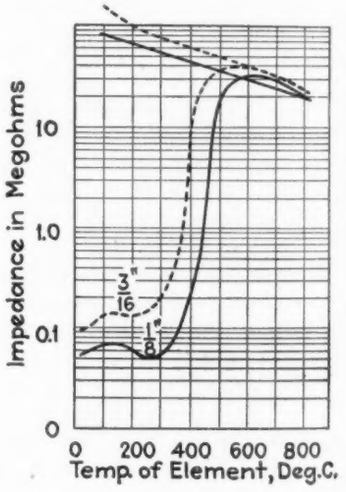
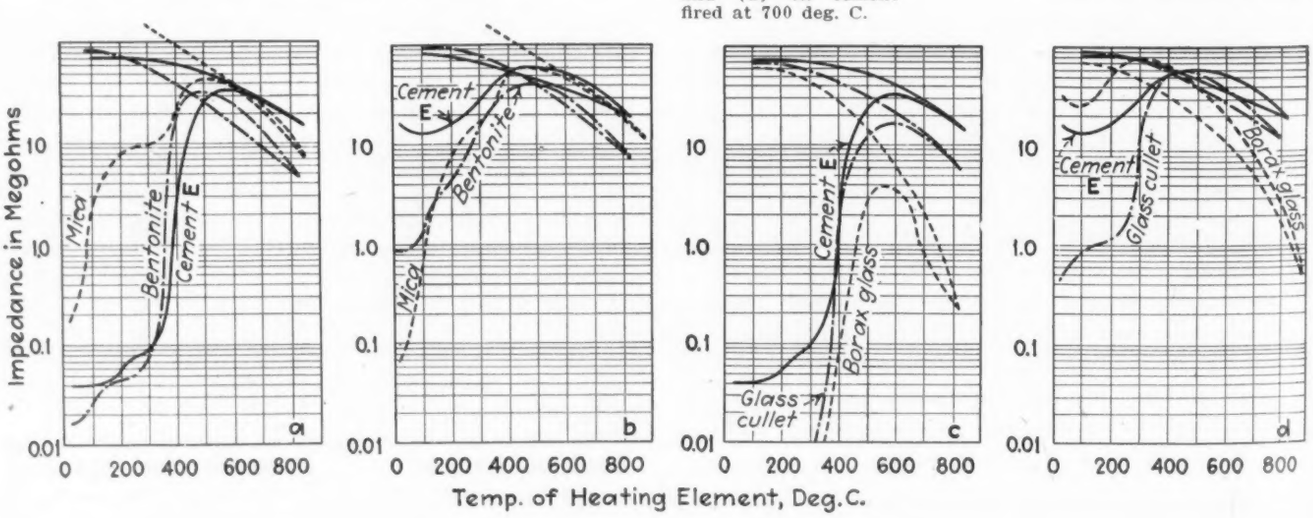


Fig. 6 — Certain ingredients promote moisture absorption

(a) Effect of mica and "Bentonite" on green cement and (b) on cement fired at 700 deg. C. (c) Effect of borax glass and glass cullet on green cement and (d) on cement fired at 700 deg. C.



used. The following table, selected from a long list of values given in chemical handbooks, indicates the range of values which may be thus secured:

Solid Phase	Per Cent Humidity at 20 Deg. C	Solid Phase	Per Cent Humidity at 20 Deg. C.
$LiCl.H_2O$	15	$NaNO_2$	66
$CaCl^2.6H_2O$	32.3	$KHSO_4$	86
$NaHSO_4.H_2O$	52	$Pb(NO_3)_2$	98

Thorough firing imperative

Results secured on the four typical cements after firing at different temperatures are shown in Fig. 4. It is at once obvious that if the hygroscopic tendencies of the cements are to be overcome a thorough firing is necessary. Only in the case of cement C is more drying of the material sufficient to overcome the danger of shock to the user by absorption of moisture. This is a cement which is particularly recommended by its producer for use where the manufacturer wishes to mature it with only the heat generated by the embedded element. Such a method of application would apparently be very inadvisable with any of the other cements tested, as indicated by the lower end of the curve for a "self-cured" unit using cement B. This curve was secured by taking the element which had been used in the "green" test, after it had been heated up, and rehumidifying it. Evidently the limited heating was insufficient to be of material assistance.

Cements A and D, in particular, appear to require more thorough heating before their use can be recommended. These two cements are probably the two most widely used of those which are at present on the market. The values for 700 deg. C. have not been secured in the latter case, but in view of the distinctly low initial resistance value, even after firing at 900 deg. C., it is apparent that firing this cement to at least this temperature is desirable.

It will be noted that in the tests shown no effort was made to determine the final resistance of the cement when the element was in equilibrium at operating temperature. In view of the slow rate of heating here used, however, it seems probable that the value which would ultimately be attained is at least of the order of magnitude shown in the various curves. There is apparently no tremendous difference between the final insulating value of any of the four cements tested once they are thoroughly dried out.

One-eighth inch thickness advocated

Another question which vitally concerns the user of cements is the thickness of the layer which he must use to secure the desired insulation. One concern is known to use consistently as little as $\frac{1}{16}$ in. This seems to be successful in its case, doubtless because, as we understand it, it employs an unusually high vitrifying temperature in maturing the units. In general, such slight thickness would seem to offer too small a margin of safety against short-circuiting by an irregularly spaced coil of the resistor.

In order to secure some idea of the increase in resistance value which would be obtained by increasing the thickness of cement used, tests were made on cement B in its "green" state, using cement layers of both $\frac{1}{8}$ and $\frac{3}{16}$ in. thickness between the resistor and the casing of the iron. (The other tests were all made on $\frac{1}{8}$-in. thick material.) The comparative values secured for cement B are shown in Fig. 5. It will be noted that at temperatures above approximately 700 deg. C. there is relatively less increase in resistance as the thickness of the cement layer is increased. This is probably due, in part at least, to the fact that the outer layer of the cement remains relatively cold throughout the test and makes up the major portion of the resistance in the circuit. As long as the outer layer remains relatively cold thickness is not a critical factor in determining the over-all resistance of the insulation.

Certain ingredients are to be avoided

Microscopic examination of the various cements indicated that the principal difference between them was in the bonding material used. A study was accordingly made of the effect of specific ingredients which might be added to the bond for the purpose of imparting plasticity or inducing low temperature vitrification, which ingredients it seemed might be fundamentally responsible for the hygroscopic behavior of the cements. In order to test this point, a special cement, which we shall designate as "E," was made by using 75 per cent of carefully sized granular refractory material and 25 per cent of a carefully prepared clay bond. This cement was then modified by the addition to it of various materials in the percentages which it was adjudged might be used to accomplish the desired objectives. These modified cements were then tested in comparison with original cement E under humidities of 86 per cent.

The results are shown in Fig. 6. From these figures it will be apparent that "Bentonite," a small percentage of which might be added to increase plasticity, lowers the final resistance of the cement and greatly increases the difficulties due to moisture absorption. While the Bentonite cement is improved by firing at 700 deg. C., its characteristics are still apparent even after that treatment. Pre-firing apparently does the cement containing mica-dust very little good in eliminating the hygroscopic difficulties. The cements to which glass cullet and borax glass were added are positively dangerous if used in their unfired condition, and the borax lowers the ultimate resistance of the cement to an objectionable degree.

The above results show the necessity for careful consideration of the method of maturing and the service conditions under which the appliances are to be used, in order to select the embedding cement best adapted for the particular application in question. They indicate serious danger of electric shock to the user from devices containing insufficiently vitrified cement, and also that such danger can be completely overcome with standard grades of cement by adequate vitrification.

$90,000,000 for Maintenance

Maintenance consumes annually about $90,000,000, or 5 per cent of the revenue of public utility systems, it is estimated on the basis of published reports. A group of such reports recently issued, most of them for a year's operation, a few covering the first quarter of 1934, was examined with a view to determine prevailing practice on this point. They were taken as they came, without any effort at selection. The results, alphabetically ar-

Summary of Maintenance Costs Compared with Revenue

(Figures are in thousands of dollars)

No.	Company	Revenue	Maintenance	Period	
1	Baltimore Consol. Gas, El. Lt. & Pwr.	$27,465	$1,080	Yr.	Dec., '33
2	Baton Rouge Electric	1,314	59	Yr.	March, '34
3	California Oregon Power	3,605	137	Yr.	Dec., '33
4	Central Illinois Public Service	2,613	222	Quar.	March, '34
5	Central Power Company	321	22	Quar.	March, '34
6	Central Power & Light	1,723	78	Quar.	March, '34
7	Commonwealth Edison	73,684	3,466	Yr.	March, '34
8	Detroit Edison	41,492	2,098	Yr.	Dec., '33
9	Duquesne Light	23,972	1,181	Yr.	Dec., '33
10	El Paso Electric	2,548	138	Yr.	March, '34
11	Gulf States Utilities	5,217	196	Yr.	March, '34
12	Inland Power & Light	4,541	237	Yr	Dec., '33
13	Key West Electric	149	15	Yr.	March, '34
14	Lake Superior District	1,367	38	Yr.	Dec., '33
15	Louisville Gas & Electric	9,518	386	Yr.	Dec., '33
16	Michigan Gas & Electric	285	15	Quar.	March, '34
17	Michigan Public Service	193	9	Quar.	March, '34
18	Mountain States Power	2,695	87	Yr.	Dec., '33
19	New Bedford Gas & Edison Lt.	3,989	261	Yr.	Dec., '33
20	Niagara Hudson	69,000	3,447	Yr.	Dec., '33
21	Northwestern Public Service	2,248	95	Yr.	Dec., '33
22	Public Service of No. Illinois	34,761	1,543	Yr.	March, '34
23	Oklahoma Gas & Electric	10,463	341	Yr.	Dec., '33
24	Puget Sound Power & Light	12,707	594	Yr.	March, '34
25	San Diego Consolidated	7,038	350	Yr.	Dec., '33
26	Savannah Electric & Power	1,757	102	Yr.	March, '34
27	Southern Colorado Power	1,698	121	Yr.	Dec., '33
28	Southwestern Gas & Electric	1,309	49	Quar.	March, '34
29	United Gas Improvement	96,221	3,939	Yr.	March, '34
30	Virginia Electric & Power	14,749	1,008	Yr.	March, '34
31	Western Public Service	1,927	79	Yr.	March, '34
32	Wisconsin Power & Light	7,619	447	Yr.	Dec., '33
33	Wisconsin Public Service	6,777	305	Yr.	Dec., '33
	Totals	$474,965	$22,145		

ranged, are shown in the accompanying table. While some of the companies supply other utility service in addition to light and power, the latter in all cases constitutes by far the major part of their operations.

It happens that the aggregate revenue is almost exactly a quarter of the annual total for the electric light and power industry as a whole, and is, therefore, large enough to serve as a fair sample. The aggregate for maintenance was about $22,000,000, from which the national total works out as $88,000,000. A ratio between 4 and 5 per cent is shown by many of the individual companies, as well as by the sum of those tabulated.

In two-thirds of the cases examined figures were at hand also for the corresponding period a year earlier. This afforded an opportunity to determine whether maintenance expenses have lately been increasing or decreasing. The conclusion was reached that there has been little change; the number of those increasing almost exactly balanced the number that decreased.

Paper Mill's $525 Capacitor Cuts $400 from Demand Charge

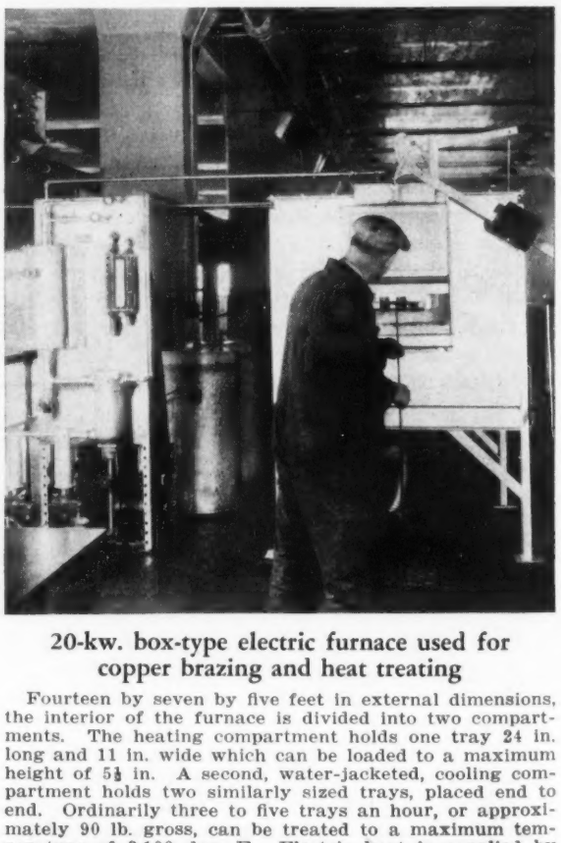
By installing a small rack-type capacitor rated at 60 kva. the Eaton Paper Company, Pittsfield, Mass., found it earned 76 per cent on its investment of $525 after deducting operating cost, depreciation, etc. Considered over a ten-year period the investment will return $4,000. The demand had been approximately 134 kva. at a power factor of 72.7 per cent.

Generating most of its own power from a reciprocating engine and using the exhaust steam for heating purposes, this company purchases very little power in the winter time and had been required to pay the high monthly demand recorded during the summer months. A survey indicated that a 60-kva. capacitor would save about $400 annually. The capacitor added was a General Electric rack type rated for two-phase, 60-cycle, 2,300-volt operation.

Service Shop Electric Furnace Handles Small Factory Needs

Widespread interest in controlled atmosphere electric furnace copper brazing by numerous small local industries has prompted the General Electric Company to install a 20-kw. unit in its Cleveland service shop. The unit is a box-type furnace and is used to take care of commercial copper brazing and similar work for numerous Cleveland industries which do not have the immediate need or financial means to install their own electric furnaces at once It serves as a demonstration unit to point out the advantages of the method to local industrial engineers and executives at first hand. Some of those showing interest in the process are manufacturers of such different products as golf club shafts, turbine steam nozzles, electric refrigerator parts and composite dies and tools of tungsten carbide alloy.

Ordinarily six parts of air are used to one part of natural gas, the constituents being supplied separately through a pair of proportioning rotometers to a combustion chamber or mixer by two compressors operated from the same 1-hp. motor. The gas which results is a mixture of nitrogen, hydrogen, carbon dioxide and



20-kw. box-type electric furnace used for copper brazing and heat treating

Fourteen by seven by five feet in external dimensions, the interior of the furnace is divided into two compartments. The heating compartment holds one tray 24 in. long and 11 in. wide which can be loaded to a maximum height of 5½ in. A second, water-jacketed, cooling compartment holds two similarly sized trays, placed end to end. Ordinarily three to five trays an hour, or approximately 90 lb. gross, can be treated to a maximum temperature of 2,100 deg. F. Electric heat is supplied by side-wall ribbon resistors with a total rating of 20 kw. at 65 volts.

Gas-mixing and scrubbing equipment to supply the reducing atmosphere are at the left.

PRACTICES IN BRIEF · · ·

carbon monoxide, the proportions varying with the original proportions of natural gas and air. This gas, its moisture condensed by passage through a cooling coil inside a water jacket, minimizes the oxidation of the work.

Switchboard Provides Safety Test Facilities

By M. J. BROOKS
Consulting Engineer, San Francisco, Calif.

A new, safe method of obtaining load data on switchboard circuits

The white test unit, with terminals brought out for the meters, is substituted for the regular fused unit, groups of the latter being assembled to form the complete panelboard. The author demonstrates the device he has developed.

Heretofore, the safety of the man making routine plant tests has often been ignored in switchboard design, a situation that has resulted in complaints about the hazards involved in even simple load measurements at the board. Hence this new development in safety switchboards for power distribution may be of interest to operating engineers.

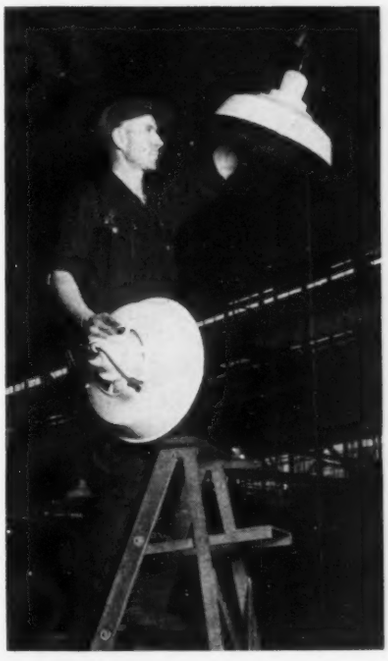
Safety in testing was a major feature in the considerations of the Stauffer Chemical Company of San Francisco in the design of a new plant distribution board and a method was evolved which both entails no hazard to the test engineer and facilitates the actual operation. The switchboard itself was built of the "Convertifuse" units assembled by the Drendell-Trumbull Electric Manufacturing Company. These units provide both a dead front and a dead rear for the panel and permit re-fusing to take place away from the board as the units are removable. Compactness is another feature of the design, which also makes "hot" terminals accessible only from the front of the board and then only by reaching back into the aperture left by the removal of the unit from the switchboard.

For testing an extra unit was made up with terminals brought out through the bakelite cap. When the load on any circuit is to be measured the meters are connected to their proper terminals on the test unit, and after all connections have been made and checked the test unit is substituted for the regular unit in the switchboard. Where a number of similar circuits emanate from one panel, as is the usual distribution practice, data on all circuits can be obtained rapidly by a repetition of the above process, it being unnecessary to disconnect the meters from the test unit. At no time is it necessary to come in contact with the switch or bus connection, a feature which compensates for the two momentary interruptions made necessary when the test unit is inserted and removed from the main board.

Considerable savings are also possible in making load tests as the entire plant can be checked in one day. Under ordinary circumstances, with other types of equipment, at least three days would be required for the test in a plant similar to the one in which this installation was made.

Clean Industrial Lights Are Effective Production Aids

By J. W. NASH
Plant Engineer Bendix Aviation Corporation, South Bend, Ind.



Speed and ease in lamp cleaning attained by detachable unit

In a large industrial plant where the number of lighting units runs well into the thousands the problem of getting the most out of the lighting installation by keeping the units clean is one that requires careful consideration. A solution of this problem in the plant of the Bendix Aviation Corporation at South Bend, Ind., is found in a special type of outlet-hanger. The conduit drop to the lighting unit terminates in a receptacle outlet whose cast housing includes a hanger hook. The lighting unit hangs in this hook by an eye and the connection plug is pushed into the receptacle. The assembly is so designed that the closed electrical connection locks the eye in the hook and the unit cannot be removed until the connection plug is pulled out. A crew of two men, one washing the units on the floor and the other substituting clean for dirty units, as shown in the illustration, can handle the lamp cleaning job on a production basis.

How to Select the Motor

First Aid for the Industrial Engineer Who Available Against Duty

By
GEORGE H. HALL
Consulting Engineer
New York

THE start of proper motorization is to find out the work to be done and not to attempt to make the work conform to motor characteristics. There are many motors of many characteristics available on the market and, in addition, there are numerous controls that will modify inherent motor characteristics, so one may say that electric motors and controls are completely flexible. They can be used to conform to work specifications, and this is the intelligent approach to industrial electrification.

An analysis of the work to be done and the best way to do the work necessitates a knowledge of factory production, of methods of testing and of motor and control so that all elements may be harmonized to give the best and most economical assembly. In an analysis of work to be done, typical questions that must be answered are: What power is required? How will this power be applied? What speed or speeds are needed? When will torque be greatest and least during the operation? In other words, a knowledge must be had of speed, torque and power relative to each instant of time during the work period.

Power can be determined by calculation, by test or by both methods. A hoist or crane power requirements can be calculated, for example, because the weight to be lifted, the rate at which the lift is made and the time allowed are specified and can be used in simple equations. Pumps, blowers and other applications also permit of quite accurate calculations.

But in many instances tests must be made to determine power requirements. One ordinary method is to use a test motor with known efficiency so that power input to this motor can be corrected to get the power needed to do the work. Unless very accurate test data are needed, it is convenient to use tables prepared by motor manufacturers instead of detail tests to get correction factors. For example, the accompanying table gives the average full load current of the different types of motors for corresponding horsepower outputs so that current readings on a test motor when referred to the table give the output horsepower quite accurately corrected for motor efficiency and power factor. Data, of course, are guides only in precision test work. The data given apply to 110, 220, 440 and 550-volt motors and a correction must be made for variations from these standard voltages. This correction is made by changing the current in inverse ratio to voltage deviation from the standard provided the voltage does not vary more than 10 per cent above or below the standard.

Another method of making tests is to use a "torquemeter" of the type shown in Fig. 1. This consists of a two-part, barrel-shaped coupling, one end of which is mounted on the shaft of the machine to be tested and the other on the shaft of the test motor. The two halves of this coupling are connected by a strong helical spring so that the entire load is carried by the spring. The two parts have a rotary motion with respect to each other in proportion to the torsion under which the spring is stressed. One of the halves is graduated in foot-pounds and the other carries a pointer by which the amount of deflection is measured.

Since the entire torquemeter revolves, provision must be made for reading the figures on the scale while it is in motion. This is accomplished by the momentary flashing of a neon lamp arranged so as to illuminate the scale for an instant at the same point in each revolution. The scale thus appears to be stationary and the figures are read easily. The lamp flash is actuated by a cam on the shaft of the torquemeter. The torquemeter reading and the speed read from a tachometer permit the horsepower to be calculated readily by the usual formula or by use of a chart the horsepower may be read directly.

In factories where a large amount of testing is involved in connection with the product manufactured convenient use may be made of the electric dynamometer. This is a special application of a direct-current motor mounted in a supporting base so that the field frame is free to rotate until restrained by a lever which, through connection arms, registers on a scale, or balance, the magnetic pull exerted on the frame by the revolving armature. As this torque on the field frame corresponds to that of the armature which is connected to the load being tested, the scale registers the foot-pounds being exerted in doing the work. From the scale reading we obtain the horsepower by the following formula:

Engineers who deal with motor applications will be interested in this summary. It shows what modern motors are now available, how they can be used and how to determine the motor requirements that best fit the work to be done. This article will be followed by a similar discussion of modern motor control and its use on the different types of drives.

for the Job

Would Match Equipment to Be Performed

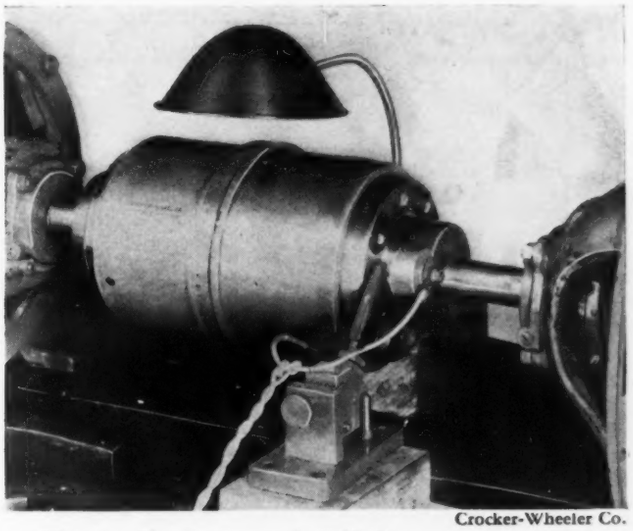
$$\text{Hp.} = \frac{\text{R.p.m.} \times \text{pounds pull (as registered on scale)}}{\text{Constant}}$$

Proper proportioning of the levers through which the torque is transmitted to the scale permits working out of this constant to some readily handled figure, such as 2,000, 3,000 or 4,000, the particular constant used depending upon the size of the dynamometer being used. Provision is made in the control for varying the speed of the armature so that load conditions may be tested under any desired range of speed.

An important factor in the analysis of power requirements, made in view of the selection of motor equipment, is that of the starting conditions. These, in general, may be classified as light, medium or normal, and heavy.

Thus in the operation of a normally rated fan or blower we meet the condition of light starting. At starting the load is solely the friction load of the shaft carrying the rotating blade, as no actual work is being performed. As the speed increases the power demand rises rapidly since the power required to drive a fan is approximately in proportion to the cube of its speed. The maximum demand will therefore be met when the fan is running at its maximum speed and the motor must be selected to meet this requirement.

A second class of machinery, such as tools, line shafting, etc., are usually started and brought up to speed before any actual work is put upon them. In such cases the starting demand is simply that needed to overcome the friction of the bearings and the inertia of the machinery. As this is but a fraction of the working load the starting power will take care of itself provided the motor is of sufficient capacity to handle the working load properly. Such starting conditions are classed as medium or normal and are amply provided for by general-purpose motors.



Crocker-Wheeler Co.

Fig. 1—Torquemeter installed to measure power requirements

The third condition of starting, the heavy, is that which is encountered in starting machines driven by heavy flywheels, extractors carrying heavy centrifugal buckets, and similar machines in which the greatest load on the driving motor will be that of acceleration. In such cases the power is used mainly to bring the heavy rotating member up to its full speed. After that much less power is required to keep it in operation. Such machines will therefore require motors which are built to provide the maximum torque during the period of starting and accelerating and the motor must be carefully selected to comply with this requirement.

Hoists, cranes and conveyors also come under the class of machines having heavy starting duty requirements, but in this case the load will not only be heavy at the start but will continue heavy after the full load speed is attained.

In the consideration of variable speeds attention must be given to the character of the load throughout the speed range. In general, the power demand through a given speed range will come within one of the following classes:

(A) Constant horsepower.
(B) Constant torque.
(C) Variable torque.

An illustration of each of these classes will be cited below:

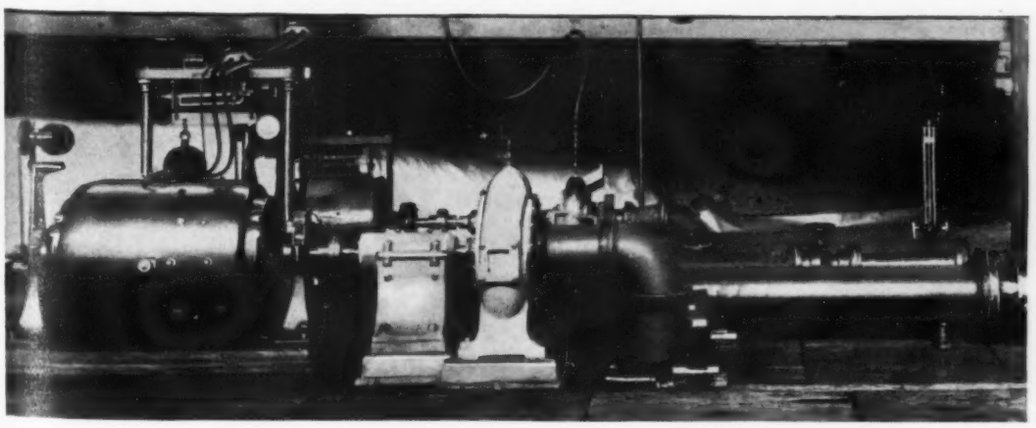


Fig. 2—A dynamometer applied to testing of centrifugal pumps
General Electric Co.

(A) Constant Horsepower—The demand of machine tools comes generally under this classification. With such tools we employ the slowest speed for the heaviest cuts and the highest speeds for the lightest cuts. As the power required to make the cut represents the

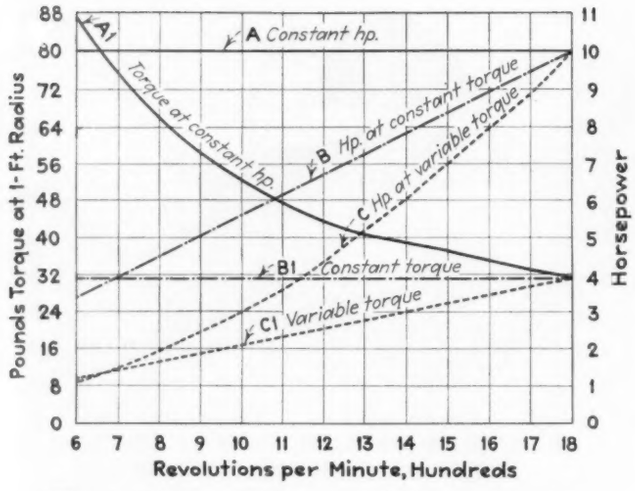


Fig. 3—Characteristics of variable-speed motors

A—Constant horsepower. B—Constant torque. C—Variable torque. Curves are drawn for a 10-hp. motor.

torque, we find that, roughly, the product of the torque and the speed will remain practically constant and a variable-speed motor for driving machines of this type should be capable of delivering constant horsepower throughout the range for which it is rated.

This will be readily appreciated by a consideration of the general formula for horsepower required to remove metal by a machine tool, Hp. $= CW$, in which W is the weight of metal removed per hour and C is a constant that has been worked out for different kinds of metal. This constant will, of course, be different for the different metals, but it will be seen that the horsepower derived from the formula will be the same whether the metal is removed by light cuts at high speed or by heavy cuts at low speed.

The power curve will therefore be a horizontal line from the point indicating rated horsepower at minimum speed to the same point at maximum speed. The torque curve will consequently have its highest point at minimum speed and its lowest point at maximum speed.

(B) Constant Torque—The conditions of this class apply to a wide field of machines which may be classed as production machines in which friction forms a high percentage of the total load. The torque which such a machine requires to produce a unit of work, or to perform a given function, is independent of the speed at which the machine runs. Thus if a given number of revolutions of the driving shaft produces a unit of the machine's product, ten times that number of revolutions will require ten times the horsepower, since the horsepower in this case is the product of the speed and a constant torque.

The power curve in this class of service will have its lowest point at minimum speed and its highest point at maximum speed, while the torque curve will be a straight line from corresponding points on both minimum and maximum speed ordinates.

(C) Variable Torque—This type of demand is illustrated by fans and blowers, the power requirements of which, at constant pressure, vary approximately with the cube of the speed. Both power and torque curves will therefore have their lowest points at minimum speed and their highest points at maximum speed.

A typical power and torque curve for a 10-hp. motor operating through a speed range of 600 to 1,800 r.p.m. under the three classes of ratings cited above is shown in Fig. 3. In the curve for variable torque, a torque varying directly as the speed has been used, as this is the customary torque variation of standard motors built for this class of service. In the case of different types of machines the variation in torque may not bear this same relation to the speed and the curve would not follow the same lines as worked out on the chart, but the general trend of the curve would be the same.

A curve for torque and power should be worked out by test for the individual machine under consideration, after which comparisons with the standard curves of commercial types of motors will quickly indicate the rating that can be adopted so that special construction can, if possible, be avoided.

After determining by test the power required to start and run any particular machine the motor should be chosen to correspond as closely as practical with this requirement. In the early days of motor application it was often the practice of the shop superintendent to determine as accurately as possible the actual horsepower that a machine required for its operation and then order a motor of 25 to 50 per cent greater capacity. This is no longer good practice. Any reputable make of open type, general-purpose motor, 200 hp. or under, and rated on a 40 deg. C. basis, will carry 15 per cent overload continuously (N.E.M.A. standard) and will not be injured by short overloads of reasonable amount.

The motor, especially the induction motor, should therefore be selected to suit its demand conditions with but little reserve capacity other than that provided by the motor itself. Induction motors when carrying but part of their rated loads operate at somewhat lower efficiencies and much lower power factors than at their full rated loads, and it is this condition that makes overmotoring undesirable, as poor power factor in a plant involves poor plant operating conditions and unnecessary expense. As an induction motor requires practically the same magnetizing current at all loads, it is readily seen that the relation of the total current to the useful current, the power factor, becomes poorer as the motor is operated below its rated capacity. This does not apply in the same

Table I—Typical Data on Full Load Current for Standard Motors

Hp. of Motor	Single Phase		Squirrel-Cage						Slip-Ring					
			Two Phase			Three Phase			Two Phase			Three Phase		
Volts	110	220	220	440	550	220	440	550	220	440	550	220	440	550
¾	9.6	4.8	2.4	1.2	1.0	2.8	1.4	1.1	3.1	1.6	1.3	3.6	1.8	1.5
1	11.0	5.5	2.8	1.4	1.1	3.3	1.7	1.3	3.4	1.7	1.4	3.9	2.0	1.6
1½	15.0	7.5	3.9	2.0	1.7	4.7	2.4	2.0	5.9	3.0	2.3	6.8	3.4	2.7
2	20.0	10.0	4.9	2.4	2.0	6.0	3.0	2.4	6.3	3.1	2.5	7.2	3.6	2.9
3	27.8	13.9	7.8	3.9	3.1	9.0	4.5	4.0	8.7	4.3	3.5	10.0	5.0	4.0
5	46.6	23.3	13.0	6.5	5.2	15.0	7.5	6.0	15.0	7.5	5.2	15.0	7.5	6.0
7½	67.6	33.8	19.0	9.5	7.6	22.0	11.0	9.0	20.0	10.0	7.6	25.0	13.0	10.0
10	86.0	43.0	24.0	11.3	9.4	27.0	14.0	11.0	24.3	12.1	10.0	28.8	14.0	11.0
15	....	....	33.0	16.5	13.2	38.0	19.0	15.0	39.0	19.5	15.6	45.0	23.0	18.0
20	....	....	45.0	22.5	18.2	52.0	26.0	21.0	49.0	24.7	19.8	56.0	28.0	22.0
25	....	....	56.0	27.7	22.2	64.0	32.0	26.0	60.0	30.0	24.0	67.0	34.0	27.0
30	....	....	67.0	33.5	27.0	77.0	39.0	31.0	72.0	36.0	28.8	82.0	41.0	33.0
40	....	....	88.0	44.0	35.5	101.0	51.0	40.0	93.0	46.5	37.3	106.0	53.0	42.0
50	....	....	109.0	54.0	43.5	125.0	63.0	50.0	113.0	57.0	45.0	128.0	64.0	51.0
60	....	....	129.0	65.0	52.0	149.0	75.0	60.0	135.0	68.0	54.0	150.0	75.0	60.0
75	....	....	156.0	78.0	62.5	180.0	90.0	72.0	164.0	82.0	65.0	188.0	94.0	75.0
100	....	....	213.0	107.0	87.0	246.0	123.0	98.0	214.0	108.0	87.0	246.0	123.0	99.0
125	....	....	270.0	134.0	109.0	310.0	155.0	124.0	270.0	135.0	108.0	310.0	155.0	124.0
150	....	....	318.0	159.0	128.0	375.0	188.0	150.0	318.0	159.0	128.0	375.0	188.0	150.0
200	....	....	425.0	214.0	172.0	500.0	250.0	200.0	425.0	214.0	172.0	500.0	250.0	200.0

For 110-volt polyphase motors multiply 220-volt figures by 2.

way to synchronous motors which are of unity or of leading power factor. Here the excess magnetizing current of an underloaded machine may be used to improve the power factor of the plant, and when this is done under well understood conditions the result of overpowering some part of the plant with synchronous motors will show a decided improvement in the plant operation.

Mechanical features must also be considered

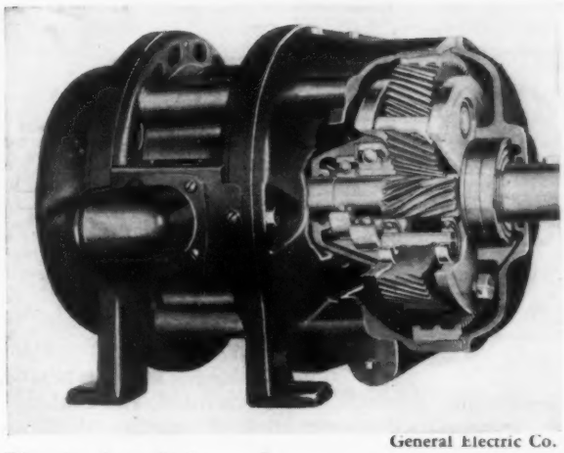
In an investigation for selection of the proper motor for any purpose mechanical features as well as electrical should be taken into consideration. In addition to securing the proper electrical characteristics it is also essential to select the frame and mounting best suited to the application.

In view of the fact that practically all motor manufacturers are now members of the National Electrical Manufacturers Association (N.E.M.A.) and follow the standards set down by the same, the motor user can be assured of uniformity in all important mechanical dimensions as well as in minimum electrical standards. Thus a motor rated a given horsepower and running at a certain speed will be mechanically interchangeable with any other motor of similar rating built by any recognized motor manufacturer. This mechanical standardization applies to motors of both horizontal and vertical construction.

Mechanical space limitations often require the use of a motor of the smallest practical dimensions, and for such purposes high-speed motors are better suited than those of the lower speeds. As the speed of an alternating-current motor for a given frequency depends upon the number of poles for which it is wound the size of motors of corresponding horsepower vary inversely with their speeds. At the same time it should be borne in mind that the cost of motors also varies inversely with the speed for any given type and horsepower. High-speed motors, however, may require the use of intermediate gears or other speed-reducing elements in cases where the speed of the driving shaft of the machine which they operate is low. It may at times be more economical to use a motor built for slow speed in order to obviate the cost of intermediate speed reduction. This point must be determined for each individual case, balancing against each other the factors of motor cost, space limitations and cost of reduction gearing. In general, it has been found that gear reduction may be used to advantage for driving speeds below 600 r.p.m., while for speeds above this the slow-speed motor will usually be more practical for the application.

A desirable compromise is often obtained by using the high-speed motor with built-in speed-reducing mechanism. The modern designs are such that the complete unit occupies comparatively little more space than the regular motor of corresponding high-speed rating, and as the gearing is combined with, and inclosed in, the motor frame it is, from the user's point of view, an integral slow-speed machine. Such reduced speed equipments if fitted with standard 1,800-r.p.m. motors may be obtained to give shaft speeds as low as 15 r.p.m.

While standard, open-type motors are satisfactory for use under a great proportion of general conditions, there are many situations where mechanical modifications are required to meet the special conditions under which the motors must operate. The most generally encountered of these conditions are:



General Electric Co.

Fig. 4—A typical gear-motor, single-reduction unit is used on many applications

Crocker-Wheeler Co.

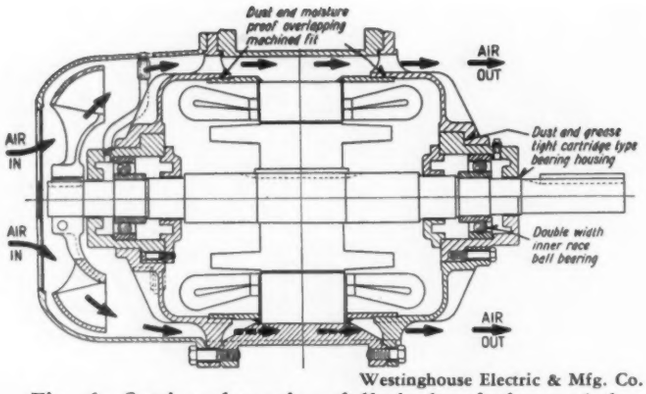
Fig. 5 — Splash-proof motor shows adaptation of design to work conditions

(a) Where motor will be subjected to dripping and splashing of water.
(b) Where the air is filled with dirt and non-explosive dust.
(c) Where the air is rendered hazardous by the presence of explosive fumes or of explosive dust.
(d) Where the motor will be exposed to the elements, as in out-of-door operation.
(e) Where the ambient temperature in which the motor operates is excessive.

Other special conditions may be encountered from time to time and further modifications may be required, but the above represent the principal adverse conditions to be looked for. They are met by the following modifications:

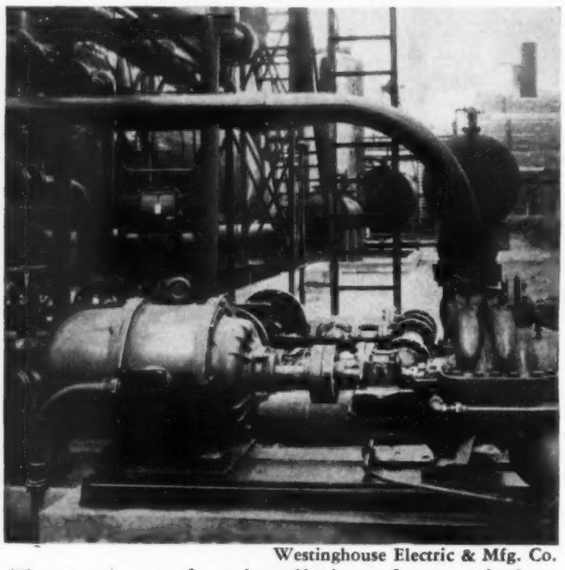
(a) Motors operating in such places as breweries, milk stations, and anywhere that there is present dripping water, or the floors of the building and the installation of machinery are subject to a daily hose washing, must have protecting shields to prevent the entrance of water into the interior of the frames. These are usually arranged as covers in such a manner as to permit adequate circulation of the air through the motor frame.

(b) When the air is very dirty it is desirable to inclose the motor to prevent the entrance of dirt and dust into the windings. For this purpose a motor may simply be fitted with solid shields by which it will be entirely inclosed. While this arrangement keeps the dirt out it also keeps the heat in, so that plain, fully-inclosed motors must be rated on a higher temperature rise than corresponding open-type machines. While fully-inclosed motors are often satisfactory for certain classes of work, especially for intermittent service, the general practice is to provide inclosed motors with ventilating fans, mounted external to the motor inclosure but integral with the motor, so as to increase the ventilation and properly dispose of the heat generated in the windings. Such motors are, in effect, totally-inclosed machines provided with a secondary casing through which the ventilating air, by action of the fan, is carried over the motor and the heat thus conducted away. Fig. 6 shows a section through a motor of this type, the arrows indicating the path of the cooling air over the motor frame. Motors of this type are provided with dust-tight bearings to prevent the entrance of dirt along the shaft into the interior of the motor.


Dust and moisture proof overlapping machined fit
AIR OUT
AIR IN
Dust and grease tight cartridge type bearing housing
AIR IN
Double width inner race ball bearing
AIR OUT

Westinghouse Electric & Mfg. Co.

Fig. 6—Section through a fully-inclosed, fan-cooled motor used on special applications



Westinghouse Electric & Mfg. Co.

Fig. 7—An outdoor installation of an explosion-proof motor in a refinery

(c) Motors for use in hazardous locations*—that is, where explosive fumes or dust are present in the air—are of the fully-inclosed fan-cooled type, but modified to meet the severe conditions of this service. Such motors are employed in gasoline-handling plants, paint factories and chemical plants, also in grain warehouses and elevators.

Since early efforts to prevent vapor from entering the motor have proved futile the present practice of construction is to so build the motor that if explosive vapors do enter the frame and become ignited the explosion will do no damage to the motor, no flame will escape, nor will the frame become heated to a temperature sufficiently high to ignite the surrounding air. This involves such special points of construction as heavily bolted frames, long bearing housings, close shaft fits, long and accurately machined fits, without gaskets, whenever parts are joined together, and the use of a ventilating fan of such material that it will not strike sparks if accidentally hit by other metal. The conduit boxes must be of extra heavy construction, capable of withstanding internal explosion in case vapor within them be ignited by sparking from loose or improper connection of the incoming wires. The general appearance of these motors is that of rigidity and strength.

For further discussion of motors for use in hazardous locations see ELECTRICAL WORLD, *February 10, 1934.*

(d) The fully inclosed, fan-cooled motor may be successfully employed in outdoor installations where the motor will be exposed to the elements. The use of such a motor obviates the necessity of providing housings and thereby offsets the additional cost of the use of this type of motor in preference to the standard open type.

Where the air may be charged with explosive fumes the explosion-proof type, as cited under (e), may also be used for outdoor installations. The explosion-proof motor is finding a wide field of application in gasoline refineries and pumping plants and a typical outdoor installation of this kind is illustrated in Fig. 7.

(e) The standard ambient, or room, temperature upon which motor ratings are based is 40 deg. C. (N.E.M.A.). As the standard temperature rise allowed in open motors is 40 deg.C. and in inclosed motors, fan cooled, is 55 deg. C. the ultimate temperature of the windings may reach 80 or 95 deg. C. and standard motors may safely operate under these maximum ultimate temperatures. If, however, the ambient temperature in which the motor is to operate is in excess of 40 deg. C the allowable temperature rise will result in an ultimate temperature greater than that for which the motor is designed and deterioration of the insulation will result. Such conditions are often found in boiler houses, laundries, etc. To meet this condition the motor must be constructed with special insulation, the composition of which will depend upon the extent to which the normal ambient temperature will be exceeded. Operation of motors under high temperatures is a matter that should be thoroughly investigated in making an installation where such conditions may be encountered, and where the conditions cannot be avoided, provision by special insulation should be made to guard against disastrous results.

While motors may be built to correspond to almost any character of power demand, mechanical limitations, or special conditions of service, there are a large number of standards which offer a wide choice, meeting nearly any conditions that may be encountered. Wherever possible these should be employed because they are standard and, therefore, from a commercial point of view, more desirable than those designed and built to special specifications.

Emergency Light in Paper Mill Obtained From Floodlamps

By A. P. SCHNYDER

Electrical Engineer, George F. Hardy, Consulting Engineer, New York

Loss of illumination in a mill when power supply fails momentarily is a serious matter, at least while the machinery continues to coast. At a Southern kraft mill this hazard was eliminated quite completely by providing emergency floodlighting at the opposite ends of the relatively long aisle of the paper-making room. The illumination is by no means equal to that obtained from the regular lighting system, but the shadows and even a measure of glare can be preferred to the dangers of sudden darkness. Turbine and boiler house and substation lighting is purposely circuited from the lighting panel to have alternate lights remain on during an emergency.

Energy supply for these emergency lights, as well as for control purposes in connection with the switching and breakers, is obtained from a storage battery in conjunction with an automatic throwover switch. When the a.c. supply again comes on the floodlights are automatically switched off and the regular lighting restored. The ampere-hour capacity of this storage battery was selected to give a one-hour output to the lights in addition to affording maximum momentary drain for electrical operation of the largest oil circuit breaker.

BOOK REVIEWS

Earth, Radio and the Stars

By Harlan T. Stetson. Published by Whittlesey House, McGraw-Hill Book Company, 330 West 42d Street, New York, N. Y. 321 pages, illustrated. Price, $3.

Astronomically our world is a maze of reactions, moon on earth motion, moon on ocean tides, axial perturbations on polar roaming, solar energy on crops. Told in most pleasing, readable manner, these familiar concepts are modernized in the first eight chapters. Beginning in the ninth we find correlation of sunspot cycles with terrestrial magnetic variations, followed by a similar correlation with radio reception and the ionosphere phenomena. Lunar cycles and solar eclipses affect radio in definite degrees, as shown in two other chapters. In a careful critique Jansky's "hiss" is attributed to other than galactic drift. The aurora is likewise subjected to electronic scrutiny. Final chapters deal with cosmic swarms and cosmic rays.

At the end the author coins the word "cosmecology" to indicate the study of the earth in relation to the cosmic scheme in which our planet is placed. Every day adds new electrical emphasis to the cosmic picture, and this book integrates all the recent deductions in a fluent narrative for astro-electronic physicists. The author is research associate in geophysics at Harvard and a prolific contributor to scientific journals.

•

Bibliography of Information on Air Conditioning

Published by the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., 46 pages.

Here is a compilation of perhaps a thousand references, chiefly to articles that have appeared during the past two or three years in periodicals, including trade magazines. It was prepared to meet the current demand for information covering air conditioning, humidification, dehumidification, insulation, refrigeration and ventilation. Workers in this field, whether on the technical or the commercial side, should find such a series of leads to original sources of information exceedingly useful. As no price is indicated it is assumed that the publication is available for distribution so long as the supply holds out.

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Year Book, American Bureau of Metal Statistics, 1933

Published by American Bureau of Metal Statistics, 33 Rector Street, New York. 112 pages.

This fourteenth annual issue of a most convenient reference work is similar to those that have come before. Aside from original data it brings together statistics for which many sources would otherwise have to be consulted. Numerous tables trace the production, recovery and consumption of non-ferrous metals in various countries throughout the world over a long series of years, show price changes and list names of mines, smelters, refineries. Most space is appropriately given to copper, lead and zinc, but statistics are given also for other metals, including the rarer and noble ones. A one-page summary of general economic statistics for the United States deserves mention.

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Die Elektrizitäts-Wirtschaft im Deutschen Reich

(The Electrical Industry in Germany)

Published by R. & H. Hoppenstedt, Seydel str. 12/13, Berlin SW19. 560 pages. Price, 32 reichsmarks.

There has long been need of a comprehensive reference work on the electric light and power industry in Germany, comparable with financial manuals on public utilities in the United States and serving similar ends. The present excellent and rather massive compilation will, therefore, be welcomed by American readers who have occasion to concern themselves with the operations of this industry in foreign countries.

It consists, in the main, of detailed statements regarding the various power companies—historical summary, corporate relationships, ownership (of especial interest are the percentages of public participation), names of directors (with designation of corporations represented by them) and of company officials, operating statistics, maps of service areas and transmission systems and copious financial data. Efforts have evidently been made to include the most recent information.

Special mention should be made of the historical and statistical summary, to which about a dozen pages are devoted.

•

Fifty Reports on Mechanical Power Transmission

By Robert W. Drake. Published by American Belting Association, 41 Park Row, New York, N. Y. 220 pages illustrated.

This book has all the qualities to make a millwright's manual as well as a handbook for superintendents of power. Moreover, it is of that class of rara avis in technical literature, a book so interestingly written as almost to hold enchained a reader who knows and cares nothing about the subject, but reads on because he likes the way the words are strung together.

A strict classification would place this book in the division of "promotional literature" because its unconcealed purpose is to forward the interests of its publisher in the sale of leather belting. Yet the purpose is so unobtrusively presented and with so little of what might be termed invidious comparison that such classification would be perhaps a little unjust. According to the title page the book is concerned with "the transmission of mechanical power from electric motor to driven machine—by belting and by other means—the problem being considered from the standpoints of design, maintenance, trouble, elimination, comparative production and comparative costs under a wide range of conditions and applications." Examination of the book shows that the subject announced on the title page has been pretty well accomplished. A feature that, while not extraordinary, is not so common as it should be, is that the book includes a detailed and competent index.

•

Les Coordonnees Symetriques En Electrotechnique

By A. Illovici. Published by J.-B. Bailliere et Fils, 19, Rue Hautefeuille, Paris, France. 284 pages, illustrated. Price, 35 francs.

After devoting two chapters to conventional vectorial representation and operations, the book proceeds with the evolution of the Stokvis-Fortescue technique of symmetrical co-ordinates. Resolution of unbalanced systems into positive and negative sequence components is accompanied by determination of the degree of unbalance. The graphical procedures described here include charts of tripolar co-ordinate areas to assist in unbalance solutions.

The analysis is thoroughly mathematical even in the sections where many transformer meshes and filters are discussed as means of resolving the components. Sums, products and quotients are comprehensively set up, as are the impedances and admittances to the symmetrical components. Parts of two chapters are devoted to faults and relay protection as founded on the symmetrical component technique.

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"Electrician" Annual Tables of Electricity Undertakings

Published by Benn Brothers, Ltd., Bouverie House, Fleet Street, London, E.C. 4. 296 pages. Price 10s. net, postage extra.

Like its forerunners, this 47th (1934) annual edition of the "Electrician" tables becomes at once the standard reference work on electric supply corporations in the United Kingdom, the Dominions and British colonies. In addition it lists many in foreign countries. The information includes population served, number of consumers, ownership, data on power plant equipment, transmission and distribution voltage, output and rates for service. The existence of controlled frequency is indicated. The large size of the pages 9¾ x 12 in.) permits of the incorporation of much more material than might otherwise be inferred from their number. The editor has done well to outline the present status of the "Grid Scheme," with a transmission map and much detailed information. Under "Foreign Undertakings" the data regarding systems in the United States impress one as being far less satisfactory than those for other countries, and less, also, than they ought to be in an important and no doubt a widely used compilation. The fault may partly be the editor's, but evidence points rather to a lack of that co-operation which generally is so conspicuously a feature of American power company policy.

NEWS OF THE WEEK

T.V.A. Offer Below Knoxville Bonds

Lilienthal makes $6,550,000 take-it-or-leave-it-before-June-20 bid for electric property of Tennessee Public Service Company following lengthy negotiation period Railway property not included, but power line is.

WITH its offer of $6,550,000 for the Tennessee Public Service Company's electric properties in Knoxville $1,230,000 less than the company's total bonded indebtedness, including railway facilities, the Tennessee Valley Authority has given the Electric Bond & Share Company until June 20 to accept or reject its bid for the properties. Thus is brought to a head the lengthy and at times acrimonious negotiations between T.V.A., the utility and the city of Knoxville, extending over the past half year. If the proposal is rejected, the city of Knoxville will proceed with the construction of a municipal power system to go into competition with the private company. A P.W.A. allotment of $2,600,000 had previously been approved for the city to build a distribution system for T.V.A. power.

In revealing the correspondence between the authority and C. E. Groesbeck of the Electric Bond & Share Company, David E. Lilienthal, T.V.A. director, announced that a report of Federal Trade Commission accountants indicated that "without any addition to the property" the company had "written up" its assets $4,560,442 during a reorganization in 1930. The alleged write-up was referred to in a letter written to Mr. Groesbeck by Mr. Lilienthal on May 28. "This write-up," the letter said, "together with other depreciation of property at the time of reorganization, totals $4,945,117. With the elimination of this write-up by writing off the common stock of $5,000,000, there is close agreement between your capitalization and the rate base of $12,000,000." The authority's announcement further revealed that it had previously offered Electric Bond & Share $5,250,000 for the properties in Knoxville, excluding a transmission line from Waterville, N. C., and the street railway system.

Power line included

That Electric Bond & Share was willing to sell the power line was indicated by the company, and in a letter dated June 12 Mr. Lilienthal offered an additional $1,300,000 for the line, bringing the total to $6,550,000 and setting June 20 as the limit for acceptance.

Officials of the Electric Bond & Share Company indicated this week that a reply would be made to Mr. Lilienthal's latest letter and public statement as soon as there had been sufficient opportunity to study them at length. The correspondence relating to the various negotiations in the Knoxville matter were made public by the Electric Bond & Share Company.

A letter from Mr. Lilienthal to Mr. Groesbeck dated May 28 reveals that a "final offer" for the Knoxville property was made on that date by T.V.A. "The Authority will pay $5,250,000 for the property in question," the letter read in part, "payable, at the option of the Authority, in cash upon delivery, or with not less than $1,500,000 cash and the balance payable over a period of not over five years."

Protection for investors?

Mr. Groesbeck replied to the letter on June 8, stating that he desired to cooperate to the greatest extent, "but in so doing we must perform the duty with which we are charged of protecting the large number of investors who have actually invested their money in the securites of the Tennessee company, all of which securities were issued with the approval of duly constituted and lawful authority . . ."

"You have offered to purchase for $5,250,000 a large part of the company's electric property. This offer, entirely aside from its adequacy, will not pay off the bonds. Your counsel, as well as our own, agree that this must be done before the properties you desire to purchase can be released from the lien of the two mortgages."

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Higher Energy Rates Foretold by Carlisle

Niagara Hudson head tells New York bankers that higher costs arising from new regulatory rulings must "inevitably" be met with increased revenues.

An inevitable increase of electric rates in New York will result if two regulatory rulings ordered by Chairman Maltbie of the Public Service Commission and temporarily stayed are adopted, Floyd L. Carlisle, chairman of the Consolidated Gas Company and Niagara Hudson Power Corporation, predicted this week. In a vigorous arraignment of public service commissions for their attempt to initiate rate proceedings and then prosecute and judge them, Mr. Carlisle told the New York State Bankers convention at Saranac Inn that the Consolidated Gas group of companies, in New York City, would be put to an expense of $6,000,000 to $7,000,000 in the next year and a half to prepare the inventory required under the recently enacted temporary rate bill.

The adoption of the straight-line depreciation principle, also ordered, would, said Mr. Carlisle, "at least double the amounts now being set aside, and which are being regarded by the companies as ample. This would be in excess of $15,000,000 additional operating expenses a year and would inevitably lead to an increase in rates.

"The revenues available for preferred and common dividends have declined over $30,000,000 since 1930, due to voluntary reductions made in 1931 and 1932, and to taxes and added costs under the NRA," Mr. Carlisle said, in reference to the New York utilities.

Floyd L. Carlisle

"The 1934 tax will exceed the amount paid the 160,000 preferred- and common-stock holders in dividends."

"There is a trend toward government regulation of practically all large business," Mr. Carlisle said. "In the modern world industrial enterprises must be either privately owned and operated or owned and operated by the government," he added. Forecasting the results of the present trend toward government regulation in business can be made possible by studying the history of public utility regulation, Mr. Carlisle held.

"Regulation inevitably results in fixing prices. The governmental agency fixing such prices does not necessarily insure the realization of such prices. No matter how elaborate a regulatory system is set up, in the last analysis, the most inexorable regulator is the law of supply and demand.

"Let me make clear that I am not advocating nor am I disapproving the attempts now being made to extend regulation beyond those enterprises heretofore regulated, but I point out that the inevitable result of regulation presents the tremendously important problem of fixing fair prices and the necessity of changing such fixed prices promptly to meet changing conditions. This has been one of the great problems of the gas and electric light business."

An additional difficulty lies in determining the degree to which regulation shall interfere with management, Mr. Carlisle said. "In the early days of public service commission regulation of utilities fact finding was the primary object sought. Now, more and more, com-

missions have come to initiate rate proceedings and to prosecute them, as well as to judge them. This problem will become of enormous importance if regulation is greatly extended to all business enterprises. Extended too far, it will kill individual initiative and so straightjacket management that it can barely function.

"We are passing through a tremendously important period in our economic history. I believe that in some form our great industries, particularly those dealing with natural resources, should have some regulation by government. I think we all ought to be open-minded, frank and candid in our approach to these problems."

•

Thayer Resigns Seat in New York Senate

Less than 24 hours after Governor Lehman of New York had issued a call for the state Senate to convene in special session on June 19, Senator Warren T. Thayer resigned his seat. The convocation order was issued for the purpose of determining if the Senator was fit to continue to hold his office, after considering the evidence taken at last month's Senate committee hearing of the relationship between the Senator and the Associated Gas & Electric Company.

In a statement accompanying his resignation the Senator declared that he believed the charges against him were to be made a political football, and rather than embarrass his Democratic friends or his Republican colleagues he believed it to be for the best interests of all that he resign.

The charges against Senator Thayer grew out of disclosures before the Federal Trade Commission last March of correspondence between the Senator and officials of Associated Gas & Electric. One letter expressed the hope that his work during the past session had been satisfactory to the company, "not so much for the new legislation enacted but from the fact that many detrimental bills which were introduced we were able to kill in my committee." Senator Thayer was chairman of the Senate committee on public service.

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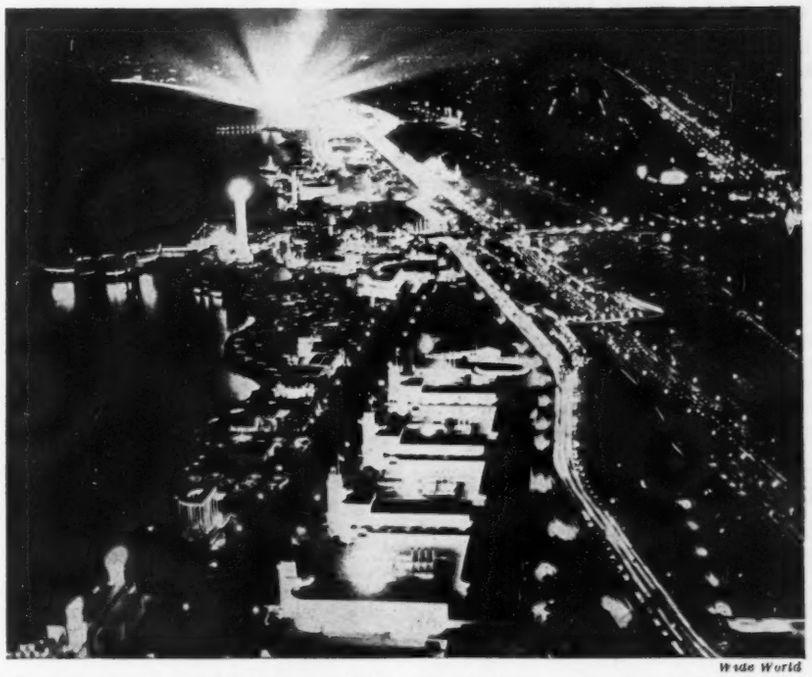
Pasadena to Oppose 60-Cycle Boulder Power

Opposition to the proposal of the Los Angeles, Calif., Bureau of Power and Light to have 60-cycle generating equipment at Boulder Dam has been announced by the city of Pasadena. The latter city serves customers on its municipal light and power department lines with energy at 50 cycles. Pasadena officials claim that the proposal would increase the city's expense in obtaining Boulder Dam power by at least $300,000. Pasadena's opposition to the use of 60-cycle generating equipment is shared, it is stated, by the municipalities of Glendale and Burbank, which now distribute 50-cycle energy purchased at wholesale from the Southern California Edison.

In the Boulder Dam contract the frequency of current has been left to the two principal contractors, the Southern California Edison Company and the Los Angeles Bureau of Power and Light. The former will generate at 50 cycles and transmit for itself and a number of privately owned power companies in the southern California area. The Bureau of Power and Light will generate and transmit power for a number of the municipalities which now have municipal distributing systems, including Pasadena, Glendale and Burbank.

LIGHT PLAYS ITS PART AT THE FAIR



Wide World

Dominating the lavish lighting of the 1934 Century of Progress Exhibition at Chicago is the illuminated fountain, largest in the world. From the 200-ft. level of the Sky Ride the brilliant panorama of the exhibition spreads southward to the multi-colored shafts of the fountain's "aurora borealis."

In the physical sciences we use the brain trust as research workers. We do not ask them to be application engineers. It is unfair to them. Application interferes with research, and the spirit of research interferes with practical application. If I had one suggestion for the Administration, it would be to separate sharply the field of research from application. Let the brain trust develop the principles. Let the experienced engineers apply them in the creation of the new, practical working machines we need.

OWEN D. YOUNG,
Chairman, General Electric Company.

Blaming present economic ills on the failure to advance social, political and economic machinery in anything like the degree that forces were being developed and applied by the physical sciences, Mr. Young held that the social sciences present the major task of the coming generation, in an address before the graduating class of the University of Nebraska last week.

Contracting Code Relief Sought

Utah utilities appeal to NRA for exemption from labor provisions in respect to appliance servicing and wiring.

First request for relief from the labor provisions of the electrical contracting subdivisional code of the construction industry, with respect to installation, servicing and repair of electrical household appliances, was made last week. The application was presented to the local board of review of NRA by the Utah Power & Light Company, Southern Utah Power Company, Telluride Power Company and People's Power Company.

The utilities contended that the code scale of 80 cents an hour is too high for this type of work and they should not be compelled to pay skilled mechanics' wages to those doing "process work." All of the companies, with the exception of Utah Power & Light, also applied for exceptions from the labor provisions of the code on wiring. They asserted that the areas they serve are made up of small, isolated communities, in which payment of code wages would result in the necessity for a radical upward revision of rate structures. The companies asked that the state be zoned, so that wages in different localities could be established in accordance with the cost of living and general economic conditions. The requests were taken under advisement by the board.

California Utilities Must Give State Data

Detailed descriptions of the holdings and property costs of California utilities have been demanded by the state Board of Equalization. Requested for the purpose of state taxation study, the first of the reports is expected by September 1 and the requested data will be collected during the month following. A formula on returns has been adopted which contemplates a detailed report by the power companies as to the cost of their tangible property. These reports will be checked against data gathered by the state board's agents in valuing the utility properties for return next year to the county taxrolls, where they will be taxed along with common property for local purposes.

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Professional Engineers Form Pennsylvania Body

The Pennsylvania Society of Professional Engineers has recently been organized to promote the interests of the state's professional engineers. With executive offices established in Philadelphia, the society has for its officers: T. W. Battin, president; Lawrence Costello and Reginald C. Scott, vice-presidents; Sheldon A. Keast, executive secretary; Walter E. Witte, financial secretary, and A. A. Townsend, treasurer.

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Commission Engineers Meet in Washington

Engineers representing nine states and the District of Columbia attended the twelfth annual conference of state utility commission engineers, held at Washington May 31 and June 1. Among the papers presented were: Customer and consumption data for residential customers, by R. E. Purucker, electrical engineer, Wisconsin; load factor in relation to rates, by Russell G. Warner, electrical engineer, Connecticut; use of indexes or cost translators in appraisals, by Harry Barker, consulting engineer, Vermont; cost of electrical distribution, by C. E. Bennett, engineer, Federal Power Commission, and public utility accidents—their causes and prevention, by L. G. Krause, chief engineer, Pennsylvania.

An executive committee elected to make all arrangements for the 1935 annual conference includes Harry Barker, Vermont, chairman; P. L. Holland, Maryland, vice-chairman; E. H. Morris, West Virginia; J. H. Wiley, North Dakota, and L. G. Krause, Pennsylvania.

COMING MEETINGS

Public Utilities Advertising Association—Annual convention, New York City, June 17-20. Eric W. Swift, Commonwealth Edison Company, Chicago, Ill.

National Association of Purchasing Agents—Annual convention, Cleveland, Ohio, June 18-21. H. Bechold, Jr., convention treasurer, Cleveland Frog & Crossing Company, 6917 Bessemer Ave., Cleveland, Ohio.

American Society of Mechanical Engineers—Semi-annual meeting, Denver, Col., June 25-28. Calvin W. Rice, 29 W. 39th St., New York.

American Institute of Electrical Engineers — Summer convention, Hot Springs, Va., June 25-29. H. H. Henline, 33 W. 39th St., New York.

American Society for Testing Materials—Annual meeting, Atlantic City, N. J., June 25-29. C. L. Warwick, 260 South Broad St., Philadelphia, Pa.

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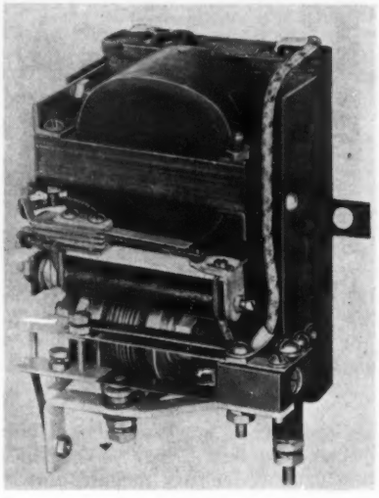
Off-Peak Water Heaters Carrier-Current Controlled



All off-peak water heaters on a system will be carrier-current operated from the power station for the first time when the equipment at Idaho Falls, Idaho, is placed in operation about July 1, according to a General Electric Company announcement. A higher load factor than by any other type of control will probably be obtained for this municipal system. Equipment for similar control of street lights in the municipality is being installed at the same time. Standard G.-E. type SCS-5 F1 carrier controllers of the type illustrated will be used for both installations with a closing impulse of 10 seconds duration and opening impulse of 30 seconds duration. The impulses are automatically timed by relays actuated by "on" and "off" push buttons.

The generating equipment consists of a three-unit motor-alternator in which a 5-hp. induction motor drives one 3-kw., 720-cycle alternator and one similar 480-cycle alternator. The first is for water-heater control and the latter for the street lights. Series-coupling transformers, similar to standard current transformers, are placed in each phase of the four feeders leaving the station. Through a plug-and-jack arrangement the operator can connect the transformers on any of the feeders to the transmitter, to give control of the water heaters on that feeder independent of all others. Load factor can thus be controlled on both the system and individual feeders.

. . . THIS WEEK IN WASHINGTON

Power and rate survey questionnaires sent to printer . . . Senate confirms Seavey nomination to Federal Power Commission . . . Federal Trade Commission utilities probe extended to January, 1935.

AFTER much reviewing and changing, the questionnaires to be sent out in connection with the general power survey and the rate survey finally were sent to the Government Printing Office this week. Due to the large amount of printing incident to the closing of a session of Congress, some delay in the printing of the schedules may result. In each survey different questionnaires will go to large and to small companies. There is a supplement for municipal plants covering features peculiar to them. For the smaller companies, both private and municipal, the power questionnaire and rate questionnaire will be combined. Care will be exercised by the Federal Power Commission to prevent these surveys from becoming an investigation into the relative merits of private and public operation of central stations. They will be confined to fact-finding.

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The Senate on June 12 confirmed the nomination of Clyde L. Seavey to be a member of the Federal Power Commission.

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Doubt that the Federal Trade Commission utilities probe would be extended beyond the end of the year was dispelled this week when the Senate adopted unanimously a resolution directing the commission to continue its investigation until January, 1936. A letter from the chairman of the commission to Senator Norris revealed that President Roosevelt himself had requested that the investigation be wound up this year.

PAUL WOOTON,
Washington Correspondent.

Northern States Power Aids Drought-Hit Farmers

All flowage lands owned by the Northern States Power Company in the state of Wisconsin were offered last week as free pasturage to drought-stricken farmers by the utility. In his communication to the state conservation commission, through which the offer was made, Glen Rork, Eau Claire division superintendent for the company, cited grazing possibilities in the areas. The only stipulation attached to the offer was that the commission delegate parceling of the various pieces of forage land to responsible persons.

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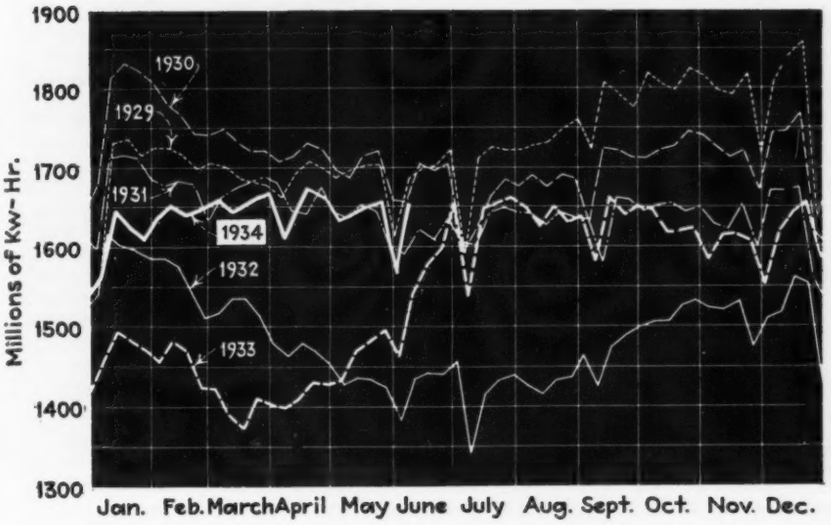
Rejects Vote for P.S.C.

Rejection of the bill providing for election by popular vote of the members of the Massachusetts Public Utilities Commission was voted last week by the state's House of Representatives. Members are now appointed by the Governor.

Week's Output Matches 1930



Returning fully to the level of the last full week in May, after the sag due to Memorial Day, the output of central electric light and power stations during the week ended June 9 amounted to 1,654,916,000 kw.-hr., according to the Edison Electric Institute. By every comparison the figures show increasing industrial activity. The output virtually matched that of the corresponding week in 1930. It missed 1929 by only 2 per cent. It left every other recent year far behind; 1931 was exceeded by 4 per cent, 1932 by 15 and 1933 by 7.4 per cent.

Weekly Output, Millions of Kw.-Hr.

1934	1933	1932
June 9...1,655	June 10...1,542	June 11...1,435
June 2...1,576	June 3...1,461	June 4...1,381
May 26...1,655	May 27...1,494	May 28...1,425
May 19...1,650	May 20...1,483	May 21...1,436
May 12...1,643	May 13...1,468	May 14...1,437

In New England alone the production failed to equal the amount reported a year ago, when that region was leading in the recovery with high percentages over 1932. Elsewhere gains over 1933 are being maintained, although the percentages are diminishing as the comparisons are made with the rapidly rising operations a year ago. They have been most firm in the Atlantic and Central areas.

Per Cent Change from Previous Year

Region	Week ended June 9	June 2	May 26
New England.....	— 2.2	+ 1.9	+ 5.4
Middle Atlantic....	+ 7.0	+ 5.6	+ 9.1
Central Industrial..	+10.3	+10.9	+13.4
West Central.....	+12.6	+14.0	+11.3
Southern States....	+ 4.5	+ 3.2	+ 5.8
Rocky Mountain...	+12.5	+23.5	+24.0
Pacific Coast.....	+ 8.6	+10.2	+15.0
United States.....	+ 7.3	+ 7.8	+10.8

Bologna-Florence Railway Direct Line Opened

One of the major links in the extensive railway electrification programs now going on in Italy, ELECTRICAL WORLD, March 24, 1934, page 453, was completed recently with the opening of the direct line from Bologna to Florence. From Bologna to Prato a new double-track line was built 51.4 miles long, and from Prato the old Bologna-Pistoia-Florence line is used. In all, the length of line between the two cities has been reduced from 136 to 77.5 miles. The major construction problem involved was the tunnel through the Apennines approximately 8.7 miles long. In its construction enormous quantities of water were found which required 25,509,000 kw.-hr. of electric sump pump energy to keep the shafts free. This water is now used for the railway requirements and for the towns of Bologna and Prato. The trolley voltage of the entire line is 3,000 volts direct current and Breda type locomotives are employed.

Energy for the new line is supplied from the power stations feeding the old one and from several new high-tension lines: Vergato-Grizzana, Grizzana-Vaiano, Suviana-Castiglione (60 kv.), Vaiano-Prato and Bologna-Rifredi (130 kv.). Three new converting substations were built at Grizzana, Vajano and Rifredi and the converting substations of Bologna and Vajoni were enlarged. A standby 2,000-kw. substation mounted on a railway car is also provided to convert 60-kv., three-phase energy to trolley voltage. Block apparatus, station lighting and other auxiliaries are supplied from a three-phase, 11-kv. line along the right-of-way, overhead in the open sections and in cable in the tunnel which is fed from four of the substations.

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Large Motors Operate After Long Submersion

Three 150-hp. motors, dried and varnished after more than four months submersion, operated through a Cuban sugar crop season without interruption, the General Electric Company reported this week. During the revolutionary troubles at Central Cespedes last summer and fall the men who took over the sugar mill would not permit keeping the water pumped out of the pits in which were located three 150-hp. motors used to drive the centrifugal pumps. Afterward the motors were taken apart and dried out in an oven made around the muffler of a 150-hp. Diesel engine. After three weeks drying the insulation resistance was found to be 5 megohms. The motors were varnished, reassembled and operated during the full sugar crop without interruption or trouble, and a subsequent insulation check showed the resistance unchanged at 5 megohms.

During the submersion extremely dirty water stood 1 to 2 ft. over the tops of the three motors. They had previously operated through thirteen crops and still have their original windings, the report states.

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April Energy Sales Rise Over March

Total 5,842,388,000 kw.-hr., an increase of 17.1 per cent over same 1933 month. Wholesale sales show rise of 28.7 per cent. Consumer revenue up 5.2 per cent.

Sales of electrical energy to ultimate consumers in April rose to 5,842,388,000 kw.-hr., an increase of 17.1 per cent over the month in 1933 and a slight increase also over March, the Edison Electric Institute announces. Total output of central stations is given as 6,894,671,000 kw.-hr., the difference representing chiefly the consumption by the companies themselves and the energy losses in transmission, conversion and distribution.

The greatest increase occurred in sales at wholesale, which rose 28.7 per cent over last year. The change is a fair measure of the enhanced industrial activity compared with the spring of 1933. Revenue from ultimate consumers was $149,851,700, or 5.2 per cent more than in April of last year, and revenue for the twelve months ended with April showed a gain of 1 per cent over the preceding like period, with a total of $1,794,903,000.

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G. E. Air Conditioners

The new and redesigned General Electric line of air-conditioning products for domestic and commercial use has been announced. Included are portable room coolers, floor-mounted room coolers, wall-mounted room coolers and suspended-type store coolers, three new types of room air conditioners and a complete line of condensing units. The latter range in capacity from ½ to 20 hp., with the 1½, 7½, 15 and 20-hp. sizes as additions to last year's line.

Coolers and conditioners are finished in dull satin walnut and feature the new aphonic pressure-type propeller fan developed by the research laboratory. This type replaces and is much quieter than the multivane blower type. Condenser units follow the same general design as formerly, with the exception of the 15 and 20-hp. sizes, in which shell and tube condensers replace the concentric-tube type. All units are redesigned for more efficient performance and increased capacity.

As to Rates . . .

San Antonio Public Service Company has issued a new schedule of rates which effects considerable reductions for residential and commercial users. The rates, applied on homes using lighting, fans, refrigerators, cooking and water heating equipment, portable appliances and motors up to 3 hp. are as follows: For first zone homes of five rooms or less, first 35 kw.-hr., 6½ cents a kilowatt-hour; next 90 kw.-hr., 4 cents; balance, 2 cents. For the second zone homes of similar size rates for the first 35 kw.-hr. are 7½ cents per kilowatt-hour; next 90 kw.-hr., 4 cents; balance at 2 cents. For more than five rooms, 5 kw.-hr. are added to the first step for each additional room. The commercial lighting rate has been lowered to 6.5 cents on the first 100 kw.-hr.

Houston Lighting & Power Company's primary residential and commercial rates have been reduced by a City Council ordinance 1 cent per kilowatt-hour. Council also passed another ordinance establishing a minimum of $25,000 annually which the Houston utility can pay the city under its present profit-sharing agreement. The only change made in the old residential rate was that the primary rate was cut from 7 cents per kilowatt-hour per room for the first 3 kw.-hr. per room to 6 cents. The higher brackets remain unchanged at 4 cents per kilowatt-hour for the next 100 kw.-hr. per room, 2½ cents for the next 500 and 1½ cents for the balance.

Missouri Electric Power Company reduced its rates in 37 cities and towns in southern Missouri, effective June 1. Rates cut are those for domestic cooking, which are reduced from 4 to 3½ cents a kilowatt-hour, and the combined lighting rate, where the minimum charge is cut from $4.95 to $2.50 or $3 a month, depending on the size of the town. Twenty-five kilowatt-hours are furnished for the minimum charge. For the second 25 kw.-hr. the rate is cut from 9.9 cents to 4 cents. The towns affected are: Advance, Ava, Arlington, Birch Tree, Bourbon, Cabool, Camdenton, Conway, Cuba, Crocker, Diggins, Dixon, Doniphan, Fordland, Houston, Jerome, Linn Creek, Mansfield, Marshfield, Mountain Grove, Mountain View, Naylor, Newburg, Neelyville, Niangua, Norwood, Oxley, Phillipsburg, Puxico, Richland, Rogersville, Seymour, Stanton, Stoutland, Swedeborg, Willow Springs and Winona.

Oklahoma Gas & Electric Company has effected a voluntary reduction in commercial lighting rates in towns and cities of more than 1,000 population, served by the company's transmission system, according to J. F. Owens, the utility's president. The saving to consumers is estimated at $200,000.

Georgia Power & Light Company's rates have been placed under investigation by the Georgia Public Service Commission. Rate reductions ordered by the commission last winter were enjoined by a federal court order, and the commission revoked the rate cut and rule *nisi* under which the proceedings were instituted. A new rule *nisi* was issued against the company last month, under which the present investigation is being made.

Mississippi Power & Light Company's proposal to reduce rates in Charleston, Miss., has been accepted by the city. The reduction ranges from 10 to 15 per cent. An offer to reduce rates 10 per cent was refused by the City Council of Greenville. The Council and the local Chamber of Commerce are demanding a 15 per cent reduction to become effective July 1.

West Coast Power Company's rates in Stevenson, Wash., and Cascade Locks, Ore., have been reduced by recent orders issued by the Department of Public Works at Olympia, Wash., and the Public Utilities Commissioner of Oregon. Residential lighting, combination residential lighting and cooking and commercial lighting schedules were affected and are made uniform in both states by the two commissions. The new residential schedule for lighting and cooking is 10 cents for the first 25 kw.-hr. and 3 cents for all over 25 kw.-hr. a month. Top steps in the former rates ran up to 14 cents for the first 10 kw.-hr. In order to make the new rates show a theoretically adequate return, the department reduced the company's property values in both states and set up a schedule of operating and maintenance costs somewhat lower than actually have existed. The properties are directly across the Columbia River from each other, connected by an overhead transmission line, and served by a hydro plant on the Oregon side.

Los Angeles Gas & Electric Corporation's revised rates covering domestic and industrial schedules have been approved by the California Railroad Commission. Under the new domestic rate schedule customers who have been paying 2 cents per kilowatt-hour for energy over and above 175 kw.-hr. consumed in one month will receive a reduction to 1½ cents per kilowatt-hour for such excess. Rates for less than 175 kw.-hr. remain the same. New low rates are to be set up for basic electrochemical and metallurgical industries.

Montana-Dakota Power Company has been ordered by the state Railroad Commission of North Dakota to file a revised schedule of rates for seven northwestern North Dakota towns that will yield a net return of 6½ per cent. The order, which also called for a reduction of 75 cents to $1.25 in the monthly minimum commercial and residential lighting charge, was made following an evaluation of the company's property at Ray, Arnegard, Rawson, Alexander, Watford City, Charbonneau and Cartwright.

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Allegan Injunction Out

An injunction restraining the city of Allegan, Mich., from issuing bonds to establish a municipal lighting plant was set aside June 6 by the U. S. Court of Appeals at Cincinnati.

Fort Worth Makes Survey of 20 Municipal Systems

As part of the plan to determine the practicability of constructing and operating a municipally owned electric light and power plant at Fort Worth, Al Vickery, city utilities engineer, has completed and reported on a study of the operation of twenty plants in Texas cities. The twenty plants have 36,693 customers and an output of 72,925,374 kw.-hr. a year. One conclusion that the report drew was: "It is true that few, if any, of the plants herein would be considered a business success if charges commonly used by private utilities were deducted, such as depreciation at 4 per cent, interest on the investment at 6 per cent, plus amortization and intercorporate transfers." Fort Worth was recently given permission by the P.W.A. authorities to apply for a $2,228,000 loan to build a municipal plant (ELECTRICAL WORLD, May 12, page 706).

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Iowa City Light & Power Resists City's P.W.A. Bid

Resistance to an application by the city of Iowa City, Iowa, for a P.W.A. loan and grant for the construction of the proposed municipal light and power plant has been filed by the Iowa City Light & Power Company, serving the municipality. The resistance declares that "the character of the campaign not only destroyed the verdict given at the polls, but vitiated the legal effect of the election." A majority vote of 155 authorized erection of the plant at the election of April 17 which is charged with fraud by the resistance. The $917,000 indebtedness to be incurred for erection of the plant would place Iowa City far in excess of limitations imposed by Iowa statutes, it also sets forth.

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California Contracts Let; P.W.A. Loan Suit Delayed

Contract for the installation of a municipal light and power plant for $139,000 has been awarded the Bacon Electric Company, Chillicothe, Ill., by the city of California, Mo. It calls for the installation of three 375-hp. generating units, switchboards, etc., and a complete distribution system. Worthington engines, Electric Machinery Manufacturing Company generators and Wagner Electric transformers will be used. The project is financed through a P.W.A. grant and loan of $155,000.

The suit filed in the Moniteau County Circuit Court by the Missouri Utilities Company attacking the right of the city to accept the P.W.A. funds will not be heard until the September term of court. The utility company has furnished the city with light and power for a number of years and now the city officials contend their franchise has expired. The bond issue of $100,000 approved by the voters of the city on October 30, 1933, has been registered with State Auditor Forrest Smith.

FINANCIAL · · · BUSINESS

Boston Edison Plans $35,000,000 Refinancing

Decision to file for registration its long-expected refinancing issue was made this week by directors of the Edison Electric Illuminating Company of Boston. Subject to Federal Trade Commission permission, the company plans to issue $35,000,000 of three-year 3 per cent coupon notes on July 16. Under the provisions of the securities act of 1933 the registration of this financing would be effective twenty days from the date of filing, which would be during the first week of July. Under this arrangement advantage could be taken of the recent amendments to last year's securities act.

Proceeds of the proposed financing would go to take up $25,000,000 of coupon notes and $7,000,000 of bank loans maturing next month. The remaining $3,000,000 would be used to reimburse the company for the amount paid out on April 16 for retirement of notes.

Utilities Act Under Bankruptcy Law

Signing of amended national bankruptcy act brings rush of reorganization petitions, both voluntary and involuntary. Midland United seeks court approval. Bondholders ask Associated Gas & Electric reorganization.

A VERITABLE rush of reorganization petitions under the recently signed McKeown bill amending the national bankruptcy act was made this week by and against public utility corporations. While the actions of several utilities now in receivership or bankruptcy were to be expected under the amended act, the action of creditor and security holder groups in petitioning for reorganizations posed a serious problem for many managements.

Chief among the voluntary petitions to reorganize under the act were those filed by Midland United Company and the Midland Utilities Company, its principal subsidiary. The petitions of the companies set forth that they are unable to meet their debts as they mature. Filed June 9, the petition to reorganize was granted in Wilmington, Del., federal court this week. "This action is taken primarily to protect the interests of the stockholders," John N. Shannahan, president, said. "A comprehensive plan of reorganization will be prepared and submitted as soon as possible."

Independently of the Delaware action, a petition on behalf of a number of security holders of Gary Electric & Gas Company, a Midland Utilities subsidiary, was filed in Chicago federal court. Early in May the Gary company had issued an extension plan for taking care of maturity of $8,000,000 of first lien collateral 5 per cent bonds on July 1, 1934. The bonds constitute sole funded debt of the company.

Middle West petition filed

A creditors' petition to place the Middle West Utilities system under the new corporate reorganization law was filed within an hour after the bill had been signed by President Roosevelt. Stating that negotiations between stockholders and creditors to effect a reorganization have been unsuccessful, the petition asserted that upon consent of two-thirds of the creditors the court can take over the company and put into effect an approved plan. The possibility of a complete elimination of stockholder equity in Middle West was seen as a result of the action. Should the creditors be able to prove the firm wholly insolvent and the court approve such finding, the stockholders could be completely eliminated from the reorganization.

A wider range of applications was made in behalf of security holders. Among such applications were a bondholders' action asking reorganization of the Associated Gas & Electric Company, the Laclede Gas Light Company, the American Electric Power Corporation and the National Public Utilities Corporation.

Five bondholders of Associated Gas & Electric filed a petition in the Utica, N. Y., federal court. The petition asks the court to appoint trustees, to continue the business and that the petitioners be permitted to submit a plan for reorganization. The creditors assert that the company is insolvent and committed an act of bankruptcy April 1 by paying interest on various debenture bonds, thus allegedly preferring some creditors over others. The petition further states that equity receivership proceedings are pending and numerous suits are being brought and asks that subsidiaries unable to meet their obligations be required to file reorganization petitions under the amended act.

Associated Gas replies

Officials of Associated Gas & Electric asserted that most of the petitioning security holders owned securities junior to the company's debentures. "The petition was apparently filed under a misunderstanding of the situation of Associated Gas & Electric Company," the statement said, "which has been considerably improved through the marked success of its plan of rearrangement of capitalization, under which a substantial majority of the outstanding debentures has already been deposited. It is reported that the application is based upon alleged insolvency of the company and inability to pay its debts as they mature, neither of which is a fact. There has been no default in the payment of interest on the debt of the company and there are no current maturities to be met."

Under the amended bankruptcy act, only a few security holders, with relatively small holdings, may combine to ask a receivership against the will of the management. If the court finds the facts alleged in the petition do not warrant such application, costs may be assessed against the petitioners.

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NRA Approves Code for Refrigeration

Approval of the code for the refrigeration subdivision of the electrical manufacturing industry and of the code authority for the electrical contracting industry were given this week by the National Recovery Administration. The code for the refrigeration subdivision becomes effective June 20. The code adopts the labor provisions of the electrical manufacturing industry code and special trade practice rules to apply to the refrigeration trade only. The industry includes 74 concerns with an aggregate capital invested of $150,000,000 and employs 40,000.

The approved code authority for the electrical contracting industry is made up of: L. E. Mayer, Chicago; E. N. Peak, Marshalltown, Iowa; D. B. Clayton, Birmingham, Ala.; Floyd Flatland, San Francisco; J. G. Livingston, New York; W. W. Ingalls, Miami, and A. J. Hixon, Boston.

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Canadian G. E. Dividend

Regular quarterly dividends of 75 cents on the common stock and 87½ cents on the preferred stock were declared last week by the Canadian General Electric Company. Both are payable July 2 to stock of record June 15.

ORTHODOXY

To a degree not appreciated by many, the Administration appears headed for a traditional course. Removal of price-fixing elements from NRA codes is becoming accepted as a portent that emphasis is to be placed on volume of trade rather than higher prices. "Brain truster" Tugwell's denunciation of previously expressed radical ideas before a Senate committee lends credence to the appearance of a more conservative Washington policy. The probability is that, whatever the causes, recovery will exhibit itself with familiar symptoms.

Sustained strength in the bond market, despite further inflationary influences, adds a note of optimism which is supported by other current indicators of business vitality. With energy production rising from its holiday slump to a level unreached for the week since 1930, steel holding its own and automobile output again on high production schedules, a new resumption of trade activity is perhaps in view. Moderate enhancement of commodity and stock prices marked a week in which the only element of doubt was cast by freight loadings, which, reflecting in part the recent holiday, showed a contra-seasonal decline.

Capital Investment in Canada Reported

Electric light and power investment for Dominion in 1932 was $1,335,886,987, census figures reveal. Ontario has high municipal plant investment.

Capital in the electric light and power industry in Canada is equivalent to 10.5 per cent of that in the United States, although the population is only 8.6 per cent. Recently reported by the Dominion Bureau of Statistics as $1,335,886,987 on the basis of its census for 1932, it compares with $12,664,376,952 as reported for the same year by the U. S. Bureau of the Census and published in the ELECTRICAL WORLD of January 6, 1934, on page 15.

Installed capacity was 30 per cent more than in 1929, the greatest change having occurred in the last year of the period. Capital increased 27 per cent, whereas generated output was 11 per cent less than in 1929. The additional construction during a time of decreased demand has meanwhile been in large measure justified by the striking growth of the output during the latter part of 1933 and the first months of 1934.

Of the Canadian total, 62 per cent of the investment is in generating stations; most of the remainder is almost equally divided between transmission and distribution. A corresponding breakdown for the United States is not available.

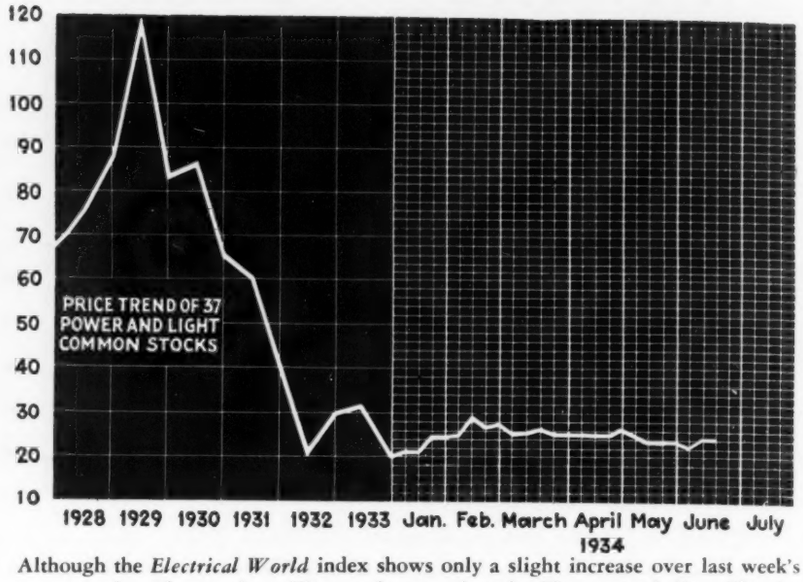
Ontario has 81% of municipal capital

As to the relative importance of governmental and commercial operation, practice differs radically in different parts of the country. Thus, while 34 per cent of the total capital is in municipal plants, by far the larger part of this is in the one province of Ontario. That province accounts for 81 per cent of the Dominion capital in municipal undertakings, but it has only 12 per cent of the investment in commercial establishments. In Quebec, directly adjacent, the conditions are reversed. It has 65 per cent of the commercial and only 1.7 per cent of the total municipal capitalization.

In domestic service, also, wide ranges appear except as to annual bills, which average $26.83 (somewhat less than in the United States) for the Dominion as a whole, while provincial averages are between $21 and $40. Annual consumption shows the extraordinary provincial maximum of 3,756 kw.-hr. per customer, coupled, as might be expected, with the minimum average rate, in Manitoba, where abundant water power has been developed close to the chief population center. The smallest average consumption is only one-tenth as large, 377 kw.-hr. in Prince Edward Island, where the average rate is 8.67 cents per kilowatt-hour. In the United States as a whole the averages for the same year were 611 kw.-hr. and 5.51 cents. In the Pacific states they were 805 kw.-hr. and 3.79 cents.

The report contains various other detailed statistics by provinces.

Utility Stocks Continue Rise



Although the *Electrical World* index shows only a slight increase over last week's average, the advance in utility stocks was broad. The general lists likewise improved. This week's index 24.5; last week 24.3.

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Commonwealth & Southern Reacquires Properties

Through its operating subsidiaries in South Carolina, Florida and Michigan, the Commonwealth & Southern Corporation has acquired several gas and electric properties in areas served by those utilities. The southern properties and several of those acquired through the Consumers Power Company, Jackson, Mich., were gas utilities.

From the Lower Peninsula Power Company two electric distribution systems were obtained, together with four hydro-electric generating plants. The properties were acquired subject to approximately $750,000 of first mortgage bonds now in the hands of the public. In connection with these acquisitions the Commonwealth & Southern Corporation has surrendered $6,663,200 Central Public Service Corporation collateral trust notes due May 1, 1936.

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Westinghouse Sales of Refrigerators Rise

Responding to the unusual demand for electric refrigerators the industry as a whole is experiencing, April refrigerator sales of Westinghouse Electric & Manufacturing Company showed a 158 per cent gain over the corresponding month of 1933, the company reports. Sales for the first four months of 1934 represent an 80 per cent increase over the same 1933 period and a 98 per cent increase over the same period of 1932.

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Laundry Appliance Shipments Rise Sharply

Shipments of household laundering equipment for the first four months of 1934 were at a rate unequaled in the history of the industry, J. R. Bohnen, secretary of the American Washing Machine Manufacturers' Association, reports. Ironers shipped in the first four months of this year totaled 168 per cent

Table I—Summary, Electric Light and Power, Canada, 1932

	Total	Commercial	Municipal
Capital ($1,000)	1,335,887	880,013	455,874
Generation	831,300	623,719	207,581
Transmission	210,340	112,974	97,366
Distribution	219,124	94,919	124,205
General	75,123	48,401	26,722
Revenue ($1,000)	121,213	73,124	48,089
Expenses (1)	74,306	30,349	43,957
Customers	1,657,454	776,400	881,054
Generator Kva	5,278,204	3,850,009	1,428,195
Output (Thous. kw.-hr.)	16,052,057	12,338,216	3,713,841

(1) Including wages, cost of fuel and power, and taxes.

Table II—Domestic Service by Provinces

Electric Light and Power Census, Canada, 1932

Province	Number of Customers	Ave. Bill (Year) Dollars	Ave. Annual Consump., Kw.-hr.	Ave. per Kw.-hr., Cents
Prince Edward Island	3,978	32.64	377	8.67
Nova Scotia	46,421	25.88	457	5.66
New Brunswick	35,543	27.33	541	5.05
Quebec	385,211	21.31	621	3.43
Ontario	585,343	27.63	1,558	1.77
Manitoba	71,954	39.93	3,756	1.06
Saskatchewan	44,952	40.10	804	4.99
Alberta	57,459	29.84	518	5.75
British Columbia and Yukon	126,601	26.45	870	3.04
Canada	**1,357,462**	**26.83**	**1,208**	**2.22**

more than the same 1933 period. Shipments of 458,039 washers in the first four months were 104 per cent above the same months in 1933.

April washer shipment figures do not show the seasonal decline ordinarily developing a month or two earlier, Mr. Bohnen reports. Shipments for the month totaled 134,846, within a few hundred of March and within 6,000 of the industry's best month, August, 1933. April ironer shipments were 246 per cent above a year ago.

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Insulator Making Filmed By Whitall Tatum

Utility executives will have an opportunity to see how glass insulators are made without leaving their desks, according to officials of the Whitall Tatum Company. A motion picture, recently produced by Whitall Tatum, shows the entire process of glass insulator manufacture, from the mixing of materials for the glass, through the casting of the insulators, their testing and packing. The film will be shown at request to any interested executive.

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Savage Arms Enters Air Conditioning Field

The Savage Arms Corporation and Air Conditioning Industries, Inc., have announced that henceforth the activities on Zephyr air equipment, development, manufacturing, merchandising, including personnel, together with full rights to patents under exclusive license, have been taken over by the arms corporation. The air conditioning department will operate as the Air Conditioning Division of the Savage Arms Corporation with sales office at New York, and engineering and plant at Utica, N. Y.

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Leonard Shipments in May Reach New High Point

Emphasizing the sales records being set by manufacturers of electric refrigeration, Leonard Refrigerator Company announces a new all-time shipping record for May. Shipments for the month not only reached a mark higher than that for any previous month in the company's 53 years of existence, but also broke the May, 1933, record by 42.3 per cent. Shipments for its current fiscal year's first seven months, ended May 31, were 68.3 per cent greater than for the corresponding period last year, it was revealed.

New York Metal Prices

	June 5, 1934 Cents per Pound	June 12, 1934 Cents per Pound
Copper, electrolytic	8.50*	9.00*
Lead, Am. S. & R. price	4.00	4.00
Antimony	8.25	7.90
Nickel ingot	35.00	35.00
Zinc, spot	4.60	4.60
Tin Straits	51.50	51.50
Aluminum, 99 per cent.	23.30	23.30

*Blue Eagle

SALES OPPORTUNITIES IN NEW CONSTRUCTION

Spot coverage of the week. Projects approved and proposed, bids requested, equipment wanted, funds available. Prospects for the electrical manufacturer.

Lindale, Ga.—Pepperill Manufacturing Company plans installation of motors and controls, conveyors, etc., in new multi-story addition to dye house at cotton mill. Cost about $100,000.

Vinton, Iowa—State Board of Education, Des Moines, plans purchase of electric generator and accessory equipment for power plant at Iowa School for Deaf, Vinton.

Peekskill, N. Y. — Standard Brands, Inc., New York, N. Y., plans installation of motors and controls, regulators, elevators, conveyors and other equipment in new multi-story gelatin manufacturing plant at Peekskill. Cost over $400,000.

Newton, Mass.—Public Building Commission asks bids until June 29 for complete electrical and mechanical equipment for city-owned incinerator plant. Fund of $200,000 has been arranged.

Knoxville, Tenn.—Tennessee Valley Authority plans transmission lines to points in Lawrence, Morgan, Limestone and Colbert Counties, Ala., where power will be furnished for commercial purposes.

Troy, Ohio—Hobart Cabinet Company plans installation of motors and controls, conveyors, etc., in connection with rebuilding of metal cabinet works recently destroyed by fire. Loss over $80,000.

Kansas City, Mo. — M. K. Goetz Brewing Company, St. Joseph, Mo., soon lets general contract for multi-story plant at Kansas City, to include power house. Cost over $400,000.

Columbus, Ohio—Plans early call for bids for extensions and improvements in city-owned electric light and power plant, including electrical units and accessories. Fund of $825,000 being arranged.

Winchester, Va. — Virginia Woolen Company plans installation of motors and controls, conveyors and other equipment in new mill addition. Cost over $65,000.

Jacksonville, Fla.—City plans extensions and improvements in electric distributing system, including lighting system. Proposed to use portion of fund of $2,500,000 to be voted at special election, June 29, for public improvements.

Hubbard, Ohio—Powell Pressed Steel Company plans installation of motors and controls, conveyors, etc., in connection with rebuilding of plant, recently destroyed by fire. Loss about $60,000.

Sharpsburg, Pa.—Construction Service, Veterans' Administration, Washington, D. C., asks bids until June 22 for boilers, stokers and other power plant equipment for institution at Aspinwall, Sharpsburg.

Arlington, Mass. — David Buttrick Company plans installation of motors and controls, conveyors, loaders and other equipment in new milk products and creamery plant. Cost about $100,000.

Stoughton, Wis.—Has voted to authorize bonds for $125,000 for installation of new standby electric generating unit and accessory equipment at city-owned electric light and power plant.

Lansing, Mich.—Board of Water and Electric Light Commissioners plans new power substation on North Larch Street.

Portsmouth, N. H. — Frank Jones Brewing Company plans rebuilding of portion of plant recently destroyed by fire. Loss $75,000, including equipment.

Fort Benning, Ga.—J. M. Raymond Construction Company, Jacksonville, Fla., has submitted low bid to Constructing Quartermaster, Fort Benning, for installation of street-lighting system and underground distribution lines, at $88,-100, and is scheduled to receive award. Plans early purchase of equipment.

Mount Clemens, Mich. — Singleyn Brewing Company, Lawyers Building, recently organized, plans new local plant. Cost over $70,000, with equipment.

Cincinnati, Ohio—Kroger Grocery & Baking Company takes bids soon for new multi-story meat-packing plant, with installation of motors and controls, conveyors, loaders, refrigerating machinery and other equipment. A $500,-000 project.

Sumner, Wash. — Washington Wineries, Inc., plans new multi-unit plant, including power house. Cost over $100,000, with equipment.

Lindsay, Calif. — Lucca Olive Oil Company plans installation of motors and controls, conveyors and other equipment in connection with rebuilding of plant, recently destroyed by fire. Loss about $90,000.

Muskogee, Okla. — City has authorized vote at general election, November 6, on bond issue of $1,250,000 for new city-owned electric light and power plant.

Killona, La.—Waterford Sugar Refinery, care of H. N. Moody, 823 Perdido Street, New Orleans, La., consulting engineer, plans installation of motors and controls, conveyors, pulverizers, loaders and other equipment for rebuilding of portion of refining plant at Killona, recently destroyed by fire. Cost about $70,000.

Kalamazoo, Mich.—Recently reported installation of lighting system at this place in these columns, costing about $60,000, was in error. City authorized such sum for purchase of cables, transformers, meters and auxiliary equipment for extensions in electric distribution lines for commercial service, and states that cable and transformers have been purchased.

Dayton, Wash. — Central Wisconsin Canneries, Inc., Beaver Dam, Wis., plans installation of motors and controls, conveyors and other equipment in new plant at Dayton. Cost over $150,000.

Los Angeles, Calif.—Knudsen Creamery Company plans installation of motors, controls, refrigerating machinery, conveyors, loaders, etc., in new multi-unit plant. Cost about $60,000.

MEN OF THE INDUSTRY

K. M. Robinson New Head of Idaho Power Company

K. M. Robinson, new president of the Idaho Power Company, first became associated with the power business in 1911. In that year he entered the employ of the Idaho-Oregon Light & Power Company, one of the predecessor companies of Idaho Power Company. Later he served as local manager, division engineer and division manager at Payette. In

1929 he went to the company's general offices in Boise in an executive capacity, rising to the position of assistant general manager in 1931. Mr. Robinson has been vice-president and general manager since last August.

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Max Stone of Wapello has been appointed manager of the Allerton office of the Iowa Southern Utilities Company. Mr. Stone succeeds E. S. Anderson, who has been transferred to Chariton.

Howard Heinz of Pittsburgh, Pa., was elected chairman of the National Industrial Conference Board at its eighteenth annual meeting held in New York recently. Virgil Jordan continues as president and chief executive.

James L. Boone has been advanced to the position of vice-president and general counsel of the Idaho Power Company. He was formerly secretary and attorney. Mr. Boone joined the company in 1926.

Joseph F. Porter, Jr., has been selected to head the Iowa City Light & Power Company. Mr. Porter was formerly assistant to his father, who is president of the Kansas City Power & Light Company.

George J. Crowdes, assistant electrical engineer of the Simplex Wire & Cable Company, Cambridge, Mass., and a member of the engineering staff of that company since 1918, has been elected chairman of the Boston section of the American Institute of Electrical Engineers. **Harold C. Hamilton,** superintendent of the department of standardization and testing, Boston Edison Company, has been made vice-chairman. **J. M. Murray,** assistant electrical engineer of the Simplex company, has been elected secretary and treasurer of the section.

Seth H. Taylor, Jr., has been appointed Pacific Coast manager for the Lincoln Electric Company, Cleveland, Ohio. He will make his headquarters at San Francisco. Mr. Taylor has been closely identified with the welding industry for the past seven years. For the past four years he has been in charge of the Los Angeles office of Lincoln Electric. He has also been engaged in the job welding business and has devoted not a little time to the study of automatic arc welding. As Pacific Coast manager, Mr. Taylor will have charge of sales and service of all Lincoln products in that territory.

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C. L. Seavey Appointed Federal Power Commissioner

Clyde L. Seavey, for eleven years a member of the California Railroad Commission, and in 1930 its president, has been designated by President Roosevelt as a member of the Federal Power Commission. His nomination, sent to the Senate last week, was confirmed this week without objection. More than thirty years of state and city service have marked Mr. Seavey's career. Beginning as deputy city assessor of Pasadena in 1900, he was in 1903 made Secretary of the State Board of Examiners, and in 1911 a member of the State Board of Control, where he served until 1915, when he was made chairman of the State Tax Commission. After two years' service in that position he again

became a member of the State Board of Control for two years. From 1921 to 1923 he was City Manager of Sacramento and also a member of the State Civil Service Commission. In 1923 he was appointed a member of the Railroad Commission of California. A native of Dixon, Ill., Mr. Seavey is a Republican. His appointment is in accordance with the law which provides that not more than three members of the commission shall be of the same political party.

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H. W. Story Elected Allis-Chalmers Executive

H. W. Story was elected vice-president and general attorney of the Allis-Chalmers Manufacturing Company at a recent meeting of the board of directors. Mr. Story entered the employ of the company in 1919 as attorney and was elected general attorney two years ago. He was born in

Milwaukee and was graduated from the University of Wisconsin in 1915. Mr. Story has served as chairman of the legislative committee of the Milwaukee Association of Commerce and for the past two years as adviser to the Industrial Commission of Wisconsin in Relation to Unemployment Insurance.

OBITUARY

Dr. James Theron Rood, for many years distinguished in electrical engineering education in the Middle West and other sections of the country, died suddenly at St. Luke's Hospital, New York City, May 23, as the result of a heart ailment. A native of Worcester, Mass., and a graduate of the Worcester Polytechnic Institute, he was engaged for a few years in electrical engineering practice with the General Electric Company at Lynn, the Bernstein Lamp Company, Boston, and the Shredded Wheat Company, Niagara Falls, N. Y., besides a short term of electric railway service at Worcester. He entered the teaching field at Clark University and subsequently became head of the physics and mathematics departments at Ursinus College. He then became professor of physics and electrical engineering at the University of Alabama, resigning in 1909 to head the same department at Lafayette College, where he remained until 1918. For two years he was professor of electric railway engineering at the University of Illinois, and from 1920

to 1929 was professor of electrical engineering at the University of Wisconsin. In 1930 he became dean of engineering at the New Mexico College of Agriculture and Mechanic Arts, returning to the East about two years ago. Dr. Rood had devoted considerable time to radio engineering in recent years and while in New Mexico directed the construction of station KOB, one of the larger broadcasting plants in the Southwest. He was well known as a consultant and combined theoretical and applied knowledge of electricity to more than the usual degree.

John S. Forbes, inventor and manufacturer, died, of pneumonia, May 25, in his sixty-ninth year. Mr. Forbes was the inventor of novel types of electric heaters and lamps. He was the recipient of the Elliott Cresson and Edward Longstreth medals of the Franklin Institute.

Dr. Robert Boveri, technical director of the well-known engineering firm of Brown, Boveri & Company, Mannheim, Germany, died recently, at the age of sixty-one. He had been associated with the business since 1900.

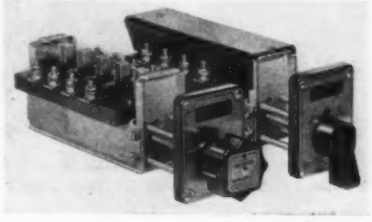
Dr. C. Francis Jenkins, inventor of the television and telephotography systems bearing his name, died last week, of heart disease, at his home in Washington, D. C. He was 66 years of age. Dr. Jenkins was widely known as an inventor in the motion-picture field as well as in television development and facsimile broadcasting. As early as July 25, 1894, he proposed a scheme for the transmission of pictures by electricity. Landmarks in his career as an inventor include the first motion-picture-by-radio demonstration in Washington on June 13, 1925, before Secretary of the Navy Wilbur and other government officials, and the first regular radio broadcast of motion pictures in July, 1928. Altogether more than 400 inventions were credited to Dr. Jenkins' ingenuity. The inventor was born near Dayton, Ohio, in 1867. He attended country schools and Earlham College in Indiana. At the age of 23 he resigned from the United States Life Saving Service "to take up inventing as a profession."

Harry Allen Currie, for the past five years electrical engineer for the New York Central Railroad, died suddenly, of angina pectoris, on June 9 in New York City. He was 62 years of age. After spending several years at sea, Mr. Currie studied electrical engineering at Cooper Union, later becoming switchboard operator in the Kent Avenue power station of the Brooklyn Rapid Transit Company. Joining the New York Central in 1903, he was placed in charge of third-rail installations for the line between Grand Central Terminal and High Bridge in 1906. He was appointed assistant electrical engineer in 1907 and electrical engineer in 1928. A fellow of the American Institute of Electrical Engineers, Mr. Currie was also consulting engineer for the electrification of the Cleveland Union Terminal several years ago.

NEW EQUIPMENT

Instrument and Control Rotary Switches

For use with all styles of circuit breakers and other electrically controlled apparatus, type R instrument and control switches have been introduced by the Roller-Smith Company, New York. Current-carrying members are rated at 15 amp. at 115 volts a.c. They are insulated for 600 volts to ground or



Roller-Smith

between contacts. The moving contacts, of the self-aligning type, bridge two fixed contacts so that pigtails and spring type connections between fixed and moving contacts are eliminated. Contact faces have silver inserts to reduce contact drop. Contacts are mounted in a molded bakelite structure with barriers between adjacent poles to increase creepage distance. The moving contact carries a plunger which passes through guides in the bakelite structure and engages with the bakelite cams mounted on the rotating shaft, which is octagonal and permits assembly for any contact sequence desired.

The bakelite structure is held between two formed steel side plates and between two formed steel end plates which also hold the bearings for the rotating shaft. Switches can be mounted on several size panels, but are supplied for mounting on 2-in. panels as standard. Dust protection is afforded by bakelite cover plates. Front plates have either standard markings or are blank for special engravings. Round notch handle is standard for instrument switches and finger-grip handles for control unless otherwise specified. Size, construction and connection details are contained in Catalog No. 9, available.

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Electrical metallic tubing, identified as "Electrunite Steeltubes," whose inside surface is processed to reduce wire pulling friction, has been offered by the Electrical Division of Steel & Tubes, Inc., Cleveland. The inside of the conduit is processed, prior to forming and welding, so that the entire surface is covered with small, round, raised knobs which produce what is referred to as a ball bearing surface. This type of surface is said to reduce surface friction 30 per cent and requires less time as well as cutting down jamming in the pulling of cables. No threading is required for installation, and the conduit will cut and bend more easily than the old style. It is available in seven sizes from ⅜ to 2 in. for open and concealed wiring except in cinder fill.

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Kelvinator Conditioners

Air conditioners suitable for meeting every type of comfort-cooling need in single-condensing unit installations in ½- to 20-ton sizes have been announced by the Kelvinator Sales Corporation, Detroit. The 24 air conditioners are provided in two types for automatic temperature control by room thermostat or for both temperature and humidity control. Both are available in self-contained, floor type, or suspended form of unit. Air conditioning coils for use in duct-type central-station systems are also available in three sizes.

The expanded condensing unit line includes the new 7½, 10, 15 and 20-hp. types. Of sixteen sizes the five smaller units from ½ to 2 hp. are air cooled, the others are water-cooled. The 7½ and 10-hp. sizes are two-cylinder, the 15 and 20-hp. sizes are V-block, four-cylinder. All new units employ shell-and-tube type condensers. The units are basic slow-speed design with bronze bearings.

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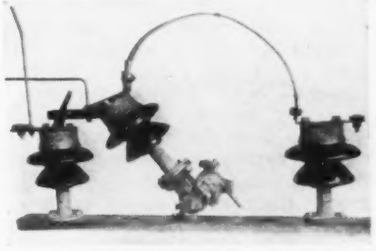
Triple-Pole Air Switches

Outdoor triple-pole air switches, types TC-1 and TC-6, employing simple contact construction and N.E.M.A. standard 3-in. bolt circle insulators, have been announced by the General Electric Com-



General Electric

pany, Schenectady. They are rated at 200 amp. at from 7.5 to 34.5 kv. Stationary contacts have a wedge-shaped end that forces its way between the movable blades through any ice which may cling to the contacts.

Ice breaking test, with the switch solidly frozen in both the open and closed positions, have proved its ability to shatter ice and to make a good line pressure contact. Other mechanical tests, consisting of 20,000 opening and closing operations, proved the reliability of this type of switch construction.

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Non-magnetic screw-holding screwdrivers, in three models, are now marketed by the Millen Manufacturing Com-

pany, 7 Water Street, Boston. Screws are gripped in a slot until released by a knurled slide easily turned and moved by the finger. One model is provided with a shock-proof handle insulated for 10 kv. and is serviceable in meter departments and for many machine assembly and maintenance tasks. The line is specially adapted to rapid handling of screws in locations difficult of access on account of narrow, deep or long-reaching surroundings.

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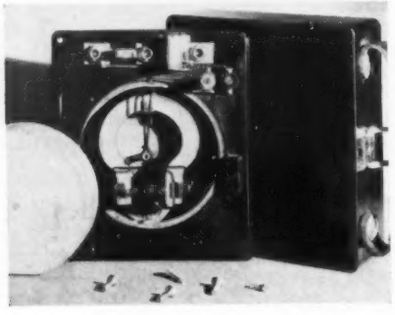
Portable Instruments Have Simplified Mounting

Standard and high-sensitivity portable d.c. instruments, type PX-5, have been announced by the Westinghouse Electric & Manufacturing Company. The movements are designed for highest accuracy in portable service. Cases are molded of "Moldarta" in four pieces—cover, case, face plate and cover plate. Repair or inspection is facilitated by mounting the complete movement on the molded face plate, which also simplifies wiring and arrangement. The bottom magnetic shield is made in cup form and when fastened in place



Westinghouse

by one bolt makes the element dust-proof and eliminates gaskets around the edge of the case. A molded cover plate incloses the upper part of the movement and the pointer and screws to the face plate.

Equipped with tungsten magnets, the meters will measure over a variety of ranges the usual volts, amperes, milliamperes, microamperes, and when equipped with high sensitivity movements with cobalt steel magnets the energy consumption is low for special measurements. The scale length is 5 in. uniformly divided into 100, 120, 125 or 150 divisions. Movements are d'Arsonval and accuracy is within ½ per cent over entire range. Case size is 7¼ x 8½ x 4 in. and weights 6 lb. 4 oz. for standard and 8 lb. for high-sensitivity types respectively. Details given in catalog section 43-120.

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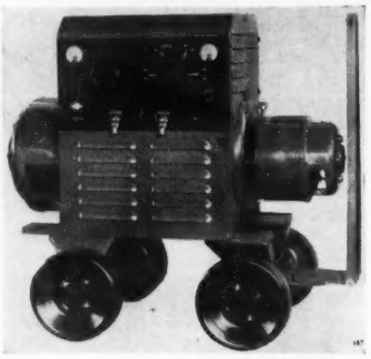
Solenoid control relays, type HG-15, have been developed by the General Electric Company for use in connection with copper oxide rectifier solenoid mechanisms. The coil of the relay operates on the d.c. side of the rectifier and its contacts on the a.c. side. When so used its contacts will successfully make and break currents up to 50 amp. at 220 volts. Complete relay with metal container weighs only 2¼ lb., and is 2½ in. wide, 4⅛ in. high and 2$\frac{15}{16}$ in. deep.

Portable Arc Welder Cuts Welding Costs

Portable arc welders which are stabilized without reactors have been announced by the Universal Power Corporation, 1719 Clarkstone Road, Cleveland.



Universal Power Corp.

The new Universal arc welders are said to have reduced to a minimum the time required for starting and the time consumed in maintaining an arc. Over-all efficiency of the units has been raised through the elimination of the current-consuming reactors to approximately 70 per cent for the induction motor-driven welder. The manufacturer claims that the saving in power and time over other welders at an energy cost of 1 to 1½ cents per kw.-hr. will return 6 per cent annually on the original cost of the machine.

The portable unit shown in the illustration weighs 1,500 lb. and is rated at 200 amp. at 40 volts. There are four main current steps with more than 600 adjustment steps possible ranging from 60 to 250 amp.

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Service Truck Ladder

Mounted completely exterior to the truck box, the Giraffe Junior service truck ladder has been announced by Charles A. Bay, Morristown, N. J. This mounting permits the use of the truck box for other purposes at all times without demounting service ladder. Five definite positions and many intermediate ones, either to right or left or along the center line of the truck, are permitted. The intermediate positions are obtained by sliding the fulcrum along the horizontal bar; it cannot slide once weight is placed on the ladder. Safety devices can be supplied to prevent car from being started once the ladder is in position and also to indicate by a light signal that the ladder is fully anchored before the operator mounts the ladder.

Charles A. Bay

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

The World's Most Modern Mill for the production of vulcanized fiber and phenol fiber, booklet of Taylor & Company, Inc., Norristown, Pa. Brief and informative illustrated description of Taylor & Company's new Norristown plant for the manufacture of vulcanized fiber and phenol fiber for application where physical and high dielectric strength are needed as well as for gears, decorative applications and other uses.

FlexArc Cletrac Welders for the remote construction and maintenance jobs, Leaflet L-20620 of the Westinghouse Electric & Manufacturing Co., East Pittsburgh. The distinctive features and construction details of tractor-driven and mounted 200, 300 or 400-amp. N.E.M.A. standard welders with illustrations showing features and units on the construction jobs.

Recommended Thicknesses of Insulation for Paper Insulated Power Cables, including oil-filled cable. Booklet B-KM-34.5 of the General Cable Corporation, New York, 14 pages, May, 1934. Gives tables of insulation thicknesses recommended jointly by the A.E.I.C. and I.P.C.E.A. Also discussed with illustrations are the features of General Cable "Segmental" and "Compack" stranded conductors, type H Compack sector cable and supercalendered high-dielectric strength paper.

Federal Signaling Equipment, Bulletin No. 41 of the Federal Electric Company, Signal Division, Chicago, 12 pages. Illustrated description of the many types of Federal signaling equipment together with associated control equipment; code sirens, industrial signals, compressed air fire alarm systems, vehicle sirens, and electric fire alarm auxiliaries are covered.

Bluehead Electric Furnaces for the Laboratory, Catalog Leaflet No. 34 of the Cooley Electric Furnace Co., Indianapolis, 6 pages. The uses, control and operation, advantages, electrical characteristics and specifications of Cooley types MP and MR muffle furnaces, types CS and CP crucible furnaces, types TO and TC combustion tube furnaces and type HP hot plates with representative illustrations.

Worthington Centrifugal Pumps of type R single-stage volute construction, Leaflet W-311-B1 of the Worthington Pump & Machinery Corporation, Harrison, N. J., 3 pages. Describes with illustration and sectional drawings Worthington type R Volute centrifugal pumps.